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ABSTRACT

The results of a five-step curriculum analysis of the automotive mechanics program at Fresno City College, California, are provided in this booklet. (An analysis of four other vocational programs are provided in CE 019 817-820.) The products of step 1 include a definition of the employment opportunity for this area and a statement of the skills/behaviors/attitudes required for employment; program curriculum objective defined specific to the stated employment requirements; performance requirements for the stated program curriculum objective; curriculum objectives of all existing vocational/occupational courses presently required for graduation from this program area; and a definition of the terminal mastery (cognitive/affective/psychomotor) which students must achieve from each non-occupational/vocational course included in the program. Step 2 includes a cognitive/affective/psychomotor analysis of each stated course objective and the criteria of mastery for each item identified. Step 3 includes an identification of items of mastery required in each course which represent problem areas for the disadvantaged student; and diagnosis/identification of the nature of the problem areas and their perceived causes in terms of student-related and curriculum/course-related causes. Step 4 includes a restatement of the priority problem area as terminal performance objectives, criterion measures for each terminal performance objective, learning requirements to achieve each objective, an organization of learning stress, and an analysis of alternate methods and media. Finally, step 5 includes specific recommendations of program/course change to eliminate identified problems and produce the required mastery. (JH)

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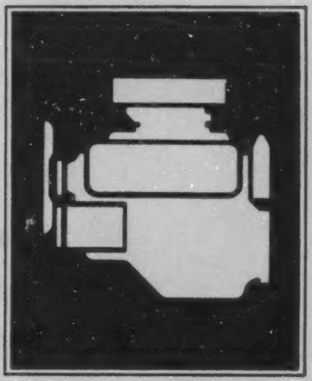
CE 019 816

"Project: MOBILITY"

A Federally Funded Research & Design Project
for
Disadvantaged and Handicapped Vocational Education Students
(Grant #G007603888)

THE FOLLOWING IS A CURRICULUM ANALYSIS
COMPLETED TO
IDENTIFY AND ELIMINATE HURDLES TO STUDENT SUCCESS IN



Automotive Mechanics

Curriculum Analysis

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June, 1978

U.S. DEPARTMENT OF HEALTH,
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NATIONAL INSTITUTE OF
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RESEARCH AND DESIGN PROJECT
CURRICULUM ANALYSIS

AUTOMOTIVE MECHANICS

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RESEARCH AND DESIGN PROJECT

CURRICULUM ANALYSIS

INTRODUCTION

The largest task undertaken in completing Phase II of this project was the thorough curriculum assessment of the five vocational education programs focused on by this project (Automotive Mechanics, Electronics, Licensed Vocational Nursing, Registered Nursing and Office Occupations). This analysis sought to identify the specific hurdles which were preventing student success; and then to determine what specific instructional methods/media changes would have to be made to eliminate them.

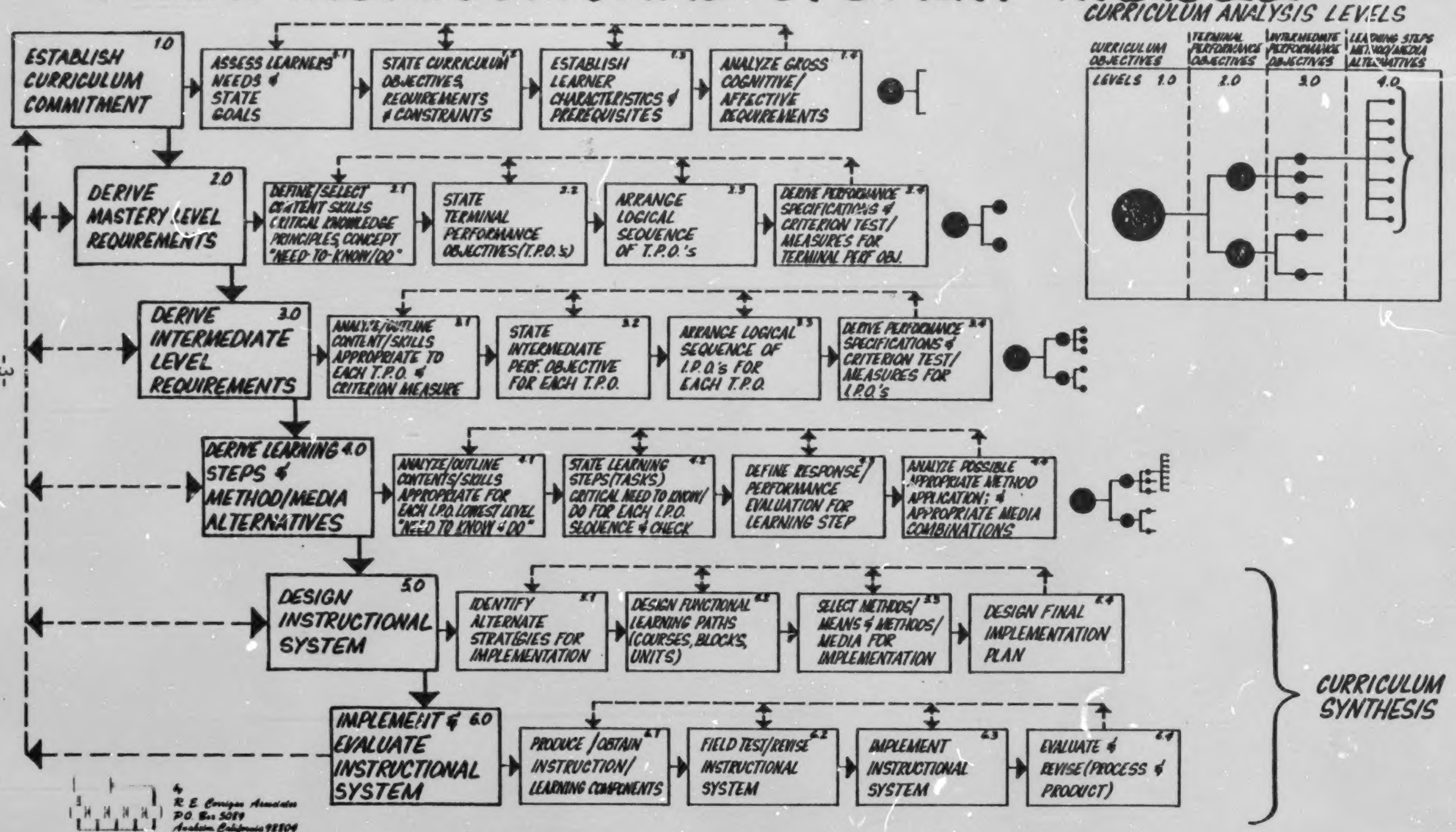
Each team worked to translate their curriculum from a norm referenced to a criterion referenced basis. Employment requirements replaced textbook tables of content as the basis of determining what should be mastered. Individual mastery replaced class standing as the standard of success or failure; and the methods and media of instruction were reassessed to determine if they were most appropriate, given the unique needs of the target students and the characteristics of the skills/knowledges/attitudes to be mastered.

The process used by each team was a highly systematic one. It sought to eliminate assumption and to standardize the curriculum analysis steps being applied by each of the five instructional design teams. All teams applied the same steps, in the same sequence, and against the same standards of completion. As much as possible, the process remained a constant. It was only the content/skills/behavior being analyzed that differed from team to team. The model of curriculum analysis that was employed can be found on page 3. All team members were trained in its application. In addition, a consultant from the developers of the model worked with each design team as they applied it to their vocational education program.

There were five general steps applied by each team. A listing of those steps can be found on pages 5 and 6. This booklet has been sectioned and bound according to those five steps. At the beginning of each section, you will be provided with a general overview of what the team did at that step. You will then be given a listing of the analysis functions performed by the team at that step. For steps 3 and 4, you will also be provided with the detailed instructions given to the team and copies of the forms they used. The curriculum analysis products developed by the team will then be provided in the sequence in which they were developed.

We hope that our effort will be of value and that the following analysis will help eliminate the hurdles which are keeping disadvantaged and/or handicapped vocational education students from successfully acquiring the skills, knowledges and attitudes they require to enter the job market place and; as a minimum, achieve their independent survival point.

SAFE INSTRUCTIONAL SYSTEM MODEL



ESTABLISH CURRICULUM COMMITMENT 1.0

ASSESS LEARNERS NEEDS & STATE GOALS 1.1

STATE CURRICULUM OBJECTIVES, REQUIREMENTS & CONSTRAINTS 1.2

ESTABLISH LEARNER CHARACTERISTICS & PREREQUISITES 1.3

ANALYZE GROSS COGNITIVE/AFFECTIVE REQUIREMENTS 1.4

DERIVE MASTERY LEVEL REQUIREMENTS 2.0

DEFINE/SELECT CONTENT SKILLS CRITICAL KNOWLEDGE PRINCIPLES, CONCEPT "NEED-TO-KNOW/DO" 2.1

STATE TERMINAL PERFORMANCE OBJECTIVES (T.P.O.'s) 2.2

ARRANGE LOGICAL SEQUENCE OF T.P.O.'s 2.3

DERIVE PERFORMANCE SPECIFICATIONS & CRITERION TEST/MEASURES FOR TERMINAL PERF OBJ. 2.4

DERIVE INTERMEDIATE LEVEL REQUIREMENTS 3.0

ANALYZE/OUTLINE CONTENT/SKILLS APPROPRIATE TO EACH T.P.O. & CRITERION MEASURE 3.1

STATE INTERMEDIATE PERF. OBJECTIVE FOR EACH T.P.O. 3.2

ARRANGE LOGICAL SEQUENCE OF I.P.O.'s FOR EACH T.P.O. 3.3

DERIVE PERFORMANCE SPECIFICATIONS & CRITERION TEST/MEASURES FOR I.P.O.'s 3.4

DERIVE LEARNING STEPS & METHOD/MEDIA ALTERNATIVES 4.0

ANALYZE/OUTLINE CONTENTS/SKILLS APPROPRIATE FOR EACH I.P.O. LOWEST LEVEL "NEED TO KNOW & DO" 4.1

STATE LEARNING STEPS (TASKS) CRITICAL NEED TO KNOW/DO FOR EACH I.P.O. SEQUENCE & CHECK 4.2

DEFINE RESPONSE/PERFORMANCE EVALUATION FOR LEARNING STEP 4.3

ANALYZE POSSIBLE APPROPRIATE METHOD APPLICATION; & APPROPRIATE MEDIA COMBINATIONS 4.4

DESIGN INSTRUCTIONAL SYSTEM 5.0

IDENTIFY ALTERNATE STRATEGIES FOR IMPLEMENTATION 5.1

DESIGN FUNCTIONAL LEARNING PATHS (COURSES, BLOCKS, UNITS) 5.2

SELECT METHODS/MEANS & METHODS/MEDIA FOR IMPLEMENTATION 5.3

DESIGN FINAL IMPLEMENTATION PLAN 5.4

IMPLEMENT & EVALUATE INSTRUCTIONAL SYSTEM 6.0

PRODUCE/OBTAIN INSTRUCTION/LEARNING COMPONENTS 6.1

FIELD TEST/REVISE INSTRUCTIONAL SYSTEM 6.2

IMPLEMENT INSTRUCTIONAL SYSTEM 6.3

EVALUATE & REVISE (PROCESS & PRODUCT) 6.4

CURRICULUM ANALYSIS LEVELS

CURRICULUM OBJECTIVES	TERMINAL PERFORMANCE OBJECTIVES	INTERMEDIATE PERFORMANCE OBJECTIVES	LEARNING STEPS METHOD/MEDIA ALTERNATIVES
LEVELS 1.0	2.0	3.0	4.0

CURRICULUM SYNTHESIS

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RESEARCH AND DESIGN PROJECT

SPECIFIC WORK ASSIGNMENTS TO BE COMPLETED BY EACH CURRICULUM DESIGN TEAM.

The following five steps will constitute the total scope of work to be completed during Phase II of the project. Establish your own work schedules and meeting times. All work is to be completed by December 16, 1977.

STEP 1

a) Derive Employment Requirements - a definition of the employment opportunity and a statement of the Skills/Behaviors/Attitudes required for employment.

b) Define your Program Curriculum Objective specific to the stated Employment Requirements - focus on required final mastery.

c) Derive Performance Requirements for the stated Program Curriculum Objective. These represent statements of all operating limitations, conditions or givens affecting the implementation or content of the Program Curriculum Objective.

d) Translate all existing courses presently required for graduation from your program area into curriculum objectives (vocational/occupational courses only).

e) Define the terminal mastery (Cognitive/Affective/Psychomotor) which students must achieve from each non-occupational/vocational course included in your program.

STEP 2

a) Perform a Cognitive/Affective/Psychomotor Analysis of each stated course objective to derive ALL highest levels of mastery required for successful completion of the course.

b) State the criteria of mastery for each item identified in the Cognitive/Affective/Psychomotor Analysis. These statements would include the method of evaluation and the level of performance required of the student (How and How Well). This statement is not the exact test item that the student would encounter (Criterion Measure).

c) Assess each course to confirm that the sequencing of the items of mastery is correct according to the taxonomies; and that the combined courses will produce the mastery demanded by the Employment Requirements and the Program Curriculum Objective (vocational/occupational courses only).

STEP 3

a) Identify those items of mastery required in each course which represent problem areas for the disadvantaged student; i.e., required proficiency levels not being attained.

b) Diagnose/Identify the nature of the problem areas and their perceived causes for performance deficiencies in terms of 1) student related and 2) curriculum/course related causes.

c) Prioritize the identified problem areas according to their criticality for continuing success by the disadvantaged student.

STEP 4

a) Restate the priority problem areas as Terminal Performance Objectives.

b) Derive Criterion Measures for each Terminal Performance Objective.

c) Analyze the Learning Requirements to Achieve each Objective.

d) Organize the learning steps.

e) Analyze alternate Methods and Media.

STEP 5

a) Define specific recommendations of program/course change to eliminate the identified problems and produce the required mastery.

RESEARCH AND DESIGN

PROJECT: MOBILITY

STEPS OF CURRICULUM ANALYSIS

STEP 1

AS THEIR FIRST STEP, THE DESIGN TEAM SEEKS OUT THE EMPLOYER'S STATEMENT OF SKILLS/KNOWLEDGES/ATTITUDES REQUIRED FOR EMPLOYMENT. THE COLLEGE'S VOCATIONAL PROGRAM AND ITS COURSES ARE THEN TRANSLATED INTO MEASURABLE PERFORMANCE OBJECTIVES.

THIS STEP CLEARLY DEFINES THE SKILLS/KNOWLEDGES AND ATTITUDES REQUIRED FOR EMPLOYMENT WHICH WILL BE THE ULTIMATE REFERENT FOR THE ENTIRE PROJECT. IT ALSO TRANSLATES THE COLLEGE'S VOCATIONAL EDUCATION PROGRAMS INTO MORE PRECISE STATEMENTS OF REQUIRED FINAL MASTERY. THIS FINAL MASTERY WILL BE THE TARGET OF ALL UPCOMING CURRICULUM ANALYSIS STEPS.

STEP 1:

A) DERIVE EMPLOYMENT REQUIREMENTS - A DEFINITION OF THE EMPLOYMENT OPPORTUNITY AND A STATEMENT OF THE SKILLS/BEHAVIORS/ATTITUDES REQUIRED FOR EMPLOYMENT.

B) DEFINE YOUR PROGRAM CURRICULUM OBJECTIVE SPECIFIC TO THE STATED EMPLOYMENT REQUIREMENTS - FOCUS ON REQUIRED FINAL MASTERY.

C) DERIVE PERFORMANCE REQUIREMENTS FOR THE STATED PROGRAM CURRICULUM OBJECTIVE. THESE REPRESENT STATEMENTS OF ALL OPERATING LIMITATIONS, CONDITIONS OR GIVEN AFFECTING THE IMPLEMENTATION OR CONTENT OF THE PROGRAM CURRICULUM OBJECTIVE.

D) TRANSLATE ALL EXISTING COURSES PRESENTLY REQUIRED FOR GRADUATION FROM YOUR PROGRAM AREA INTO CURRICULUM OBJECTIVES (VOCATIONAL/OCCUPATIONAL COURSES ONLY).

E) DEFINE THE TERMINAL MASTERY (COGNITIVE/AFFECTIVE/PSYCHOMOTOR) WHICH STUDENTS MUST ACHIEVE FROM EACH NON-OCCUPATIONAL/VOCATIONAL COURSE INCLUDED IN YOUR PROGRAM.

RESEARCH AND DESIGN
AUTOMOTIVE MECHANICS

Job Entry Requirements
To Become Apprentice Mechanics

What the Student Needs to Know:

1. Good safety practices when working with common tools and materials related to automotive service repair
    a. Importance of proper ventilation
    b. Proper means of raising and locking vehicles on hydraulic service lifts and jacks
    c. Proper use of fire extinguishers for different types of fires
    d. The importance of good housekeeping by maintaining clean tools and work areas
    e. Proper storage of cleaners and other flammables
    f. Safe procedures when lifting or moving parts or equipment

2. How to use and maintain common handtools and specialty tools and equipment

3. How to read and use manufacturer's shop manuals

4. How to use general shop manuals

5. How to use the flat rate manuals

6. How to locate and use manufacturer's specifications

7. How to write repair orders

8. The basic principles of gas engine operation
    a. Operation of a two-cycle engine
    b. Operation of a four-cycle engine
    c. Principle of energy and its application to the gas engine
    d. Principles of combustion and its relationship to the gas engine
    e. Chemical reactions involved in the operation of a gas engine
    f. Operation of the valve system in different types of engines
    g. Compression and firing order as related to valve and piston systems
    h. Horsepower and how ratings are increased and decreased
    i. Different cams and how they affect the operation of the engine
    j. Different types of heads
    k. Different types of pistons and ring combinations and their effect on internal combustion engines
    l. Structure of the internal combustion engine and its balance. How to relate vibrations to engine failure.

9. The engine lubrication system
    a. Manufacturer's oil requirements for lubrication specifications
    b. Properties of different types of filters

10. Cooling systems, coolant and pressure requirements

11. Engine exhaust system

12. Electrical systems
    a. Fundamentals of electricity pertaining to automobiles
    b. Storage battery
    c. Charging system
    d. Starting system
    e. Ignition system
    f. Principles of operation of automotive wiring system
    g. Headlamp adjusting

13. Fuel system
    a. Carburetor
    b. Fuel pump
    c. Fuel tank
    d. Fuel filters

14. Emission control
    a. Crankcase devices
    b. Exhaust emission systems
    c. Evaporative emission control

15. Engine tune-up procedures including test equipment

16. Automotive air conditioning
    a. Theory and system operation
    b. System components
    c. System servicing
    d. System diagnosis
    e. System repair

17. Different types of suspension systems
    a. Purposes of front end suspension
    b. Rigid axle suspension system
    c. Independent suspension systems, including short and long arm
    d. Front end geometry
    e. Degree charts
    f. Thickness guages
    g. Micrometers
    h. Dial indicators

18. Equipment used in and the importance of wheel balancing in automobiles
    a. The effects of wheels out of balance
        1. Uneven tire wear
        2. Rough ride
        3. Road tramp
        4. Excessive wear
    b. Static and dynamic wheel balancers

19. The importance and purposes of wheel bearings
    a. Basic types of wheel bearings

        1. Ball
        2. Taper
        3. Roller
        4. Barrel
    b. Wheel bearing service
        1. Cleaning
        2. Inspecting
        3. Lubricating
        4. Adjusting
    c. The effects of improperly serviced wheel bearings

20. Shock absorbers
    a. The purpose of shock absorbers
    b. Appropriate types of shock absorbers for appropriate conditions, including knowledge of double action telescope and single action telescope

21. Springs and their importance to the front end assembly
    a. Leaf type springs in automobiles
    b. Coil springs
    c. Torsion bars and their application to appropriate automobiles, as well as their purposes and benefits

22. Ball joints as applicable to automobiles
    a. Purposes of ball joints
    b. Construction of different manufacturer's types
    c. The effects of excessively worn ball joints

23. Alignment racks and their operation
    a. Loose or worn suspension parts
    b. Front and rear wheel alignment procedures
    c. How to check and adjust castor, camber, and toe-in as appropriate

24. Trouble shooting as appropriate to front end repairman
    a. Hard steering problems
    b. Excessive looseness
    c. Erratic steering in application of brakes
    d. Pulling to one side
    e. Scuffed tires
    f. Cupped tires
    g. Front wheel shimmy
    h. Front or rear wheel tramp
    i. Wandering

25. Brake systems as related to automotive service repair
    a. The function of basic brake tools
    b. The use and operation of a brake drum lathe
    c. An arc grinding machine

- d. The use and operation of a pressure bleeder
- e. Defective parts of a brake system
- f. Master cylinders
- g. Basic parts of a wheel cylinder
- h. Disc brake caliper assembly
- i. Inspection and adjustment of brake shoes and pads
- j. Different types of parking brakes
- k. How to install front and rear wheels, check bearings, pack bearings, and safety test vehicle.

26. Trade safety practices and working regulations

27. History of the automotive transmission
    - a. Standard
    - b. Automatic

28. Different types of power trians systems
    - a. Clutch
    - b. Trans
    - c. Drive line
    - d. Differential
    - e. Axles

29. The purpose of the transmission and power trians
    - a. Standard
    - b. Automatic
    - c. Front wheel drive
    - d. Rear wheel drive
    - e. Trans-axles

30. How to use special tools for transmission repair and service, according to type (automatic and standard)
    - a. GM
    - b. Ford
    - c. Chrys
    - d. AMC

31. Construction and operating principles of transmissions
    - a. Standard - 3 speed and 4 speed
    - b. Automatic

32. Types of clutches
    - a. Single clutch
    - b. Multiple clutch
    - c. Hydraulic clutch
    - d. Fluid clutch
    - e. Torque converter
    - f. One way clutch

33. U joints and drive lines

Research and Design Project, Automotive Mechanics
Job Entry Requirements (Continued)

34. Differential types
    a. Standard
    b. Limited slip

35. Axle Types
    a. Semi-floating
    b. Full-floating
    c. Swinging axle
    d. De Dion axle

36. Types of drives
    a. Torque tube
    b. Hotchkiss
    c. Control arm
    d. Trans-axle

Employment Opportunities

1. Apprentice mechanic

2. Speciality mechanic

    a. Front end
    b. Brakes
    c. Engine (machinist)
    d. Tune-up
    e. Air conditioning
    f. Transmission
    g. Engine

3. Small engines mechanic: lawn mowers, boats, motorcycles

ON THE FOLLOWING PAGES, YOU ARE PROVIDED WITH AN ANALYSIS OF THE ENTRY-LEVEL SKILLS/KNOWLEDGES/ATTITUDES REQUIRED TO SUCCEED IN THIS OCCUPATIONAL AREA. THE INFORMATION IS TAKEN FROM THE DICTIONARY OF OCCUPATIONAL TITLES, D.O.T., COMPILED BY THE DEPARTMENT OF LABOR.

THIS ANALYSIS IS ONE OF SEVERAL SOURCES USED BY THE PROJECT DURING PHASE II TO DEFINE THE LEVELS AT WHICH A STUDENT WOULD HAVE TO BE ABLE TO PERFORM IN ORDER TO ENTER AND SUCCEED IN THIS PROGRAM. THESE LEVELS FURTHER SERVED TO HELP PUT LIMITS ON REMEDIAL PROGRAMS DESIGNED TO BRING A STUDENT UP TO ENTRY-LEVEL STANDARDS.

RESEARCH DESIGN PROJECT FOR DISADVANTAGED STUDENTS DOT INFORMATION SHEET

OCCUPATIONAL EDUCATION
NOV 15 1977

VOCATIONAL PROGRAM: Auto Cluster

WORKER TRAIT NUMBER THIS VOCATIONAL CLUSTER: .281 & .381

JOBS WITHIN THIS VOCATIONAL CLUSTER:

Job	DOT Number
Air Conditioning Mechanic	620.281
Carburator Man	620.281
Automotive Diagnostic Tester	620.381

BREAK-DOWN OF VOCATIONAL CLUSTER WORKER TRAIT INFORMATION:

A. CLUSTER: Auto Cluster

B. JOB: Air Cond. Mech. & Carburator Man DOT NUMBER 620.281

C. WORKER TRAITS RELATED TO DATA, PEOPLE, THINGS:
   a. Analyzing
   b. No significant relationship
   c. Precision working

D. GENERAL EDUCATIONAL DEVELOPED REQUIRED:

1. Reasoning Development -- Level __ 4 & 3

4. Apply principles of rational systems to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. Interpret a variety of instructions furnished in written, oral, diagrammatic, or schedule form.

3. Apply common sense understanding to carry out instructions furnished in written, oral, or diagrammatic form. Deal with problems unvolving several concrete variables in or from standardized situations.

D.GENERAL EDUCATIONAL DEVELOPMENT REQUIRED Con't.

2. Matematical Development, Level 4 & 3

4. Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.

3. Make arithmetic calculations involving fractions, decimals and percentages.

3. Language Developmemt, Level 4 & 3

4. Comprehension and expression of a level to: - Transcribe dictation, make appointments for executive and handle his personal mail, interview and screen people wishing to speak to him, and write routine correspondence on own initiative. - Interview job applicants to determine work best suited for their abilities and experience, and contact employers to interest them in services of agency. - Interpret technical manuals as well as drawings and specifications, such as layouts, blueprints, and schematics.

3. Comprehension and expression of a level to - File, post, and mail such material as forms, checks, receipts, and bills. - (p. 2 a)

E. APTITUDES; Specific capabilities and abilities required in order to learn or perform adequately a job duty.

Aptitude	Level	Explanation
G	3	INTELLIGENCE: General learning about ability. The ability to "catch on" or understand instructions and underlying principles. Ability to reason & make judgments. Closely related to doing well in school. (3) The middle third of the population. This segment of the population possesses a medium degree of the aptitude, ranging from slightly below to slightly above average.
V	3	VERBAL: Ability to understand meanings of words and ideas associated with them, and to use them effectively. To comprehend language, to understand relationships between words, and to understand meanings of whole sentences and paragraphs. To present information or ideas clearly. (3) See above.

Cont. P 2a.

LANGUAGE DEVELOPMENT (Continued)

- Copy data from one record to another, fill in report forms, and type all work from rough draft or corrected copy. - Interview members of household to obtain such information as age, occupation, and number of children, to be used as data for surveys, or economic studies. - Guide people on tours through historical or public buildings, describing such features as size, value, and points of interest.

* *

APTITUDES (Continued)

Aptitude	Level	Explanation
N	3	NUMERICAL: Ability to perform arithmetic operations quickly and accurately. (3) See above.
S	2	SPATIAL: Ability to comprehend forms in space and understand relationships of plane and solid objects. May be used in such tasks as blueprint reading, and in solving geometry problems. Frequently described as the ability to "visualize" objects of two or three dimensions, or to think visually of geometric forms. (2) The highest third exclusive of the top 10 percent of the population. This segment of the population possesses an above average or high degree of the aptitude.
P	3	FORM PERCEPTION: Ability to perceive pertinent detail in objects or in pictorial or graphic material; To make visual comparisons and discriminations and see slight differences in shapes and shadings of figures and widths and lengths of lines. (3) See above.
K	3	MOTOR COORDINATION: Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and quickly. (3) See above.
M	3	MANUAL DEXTERITY: Ability to move the hands easily and skillfully. To work with the hands in placing and turning motions. (3) See above.

E. SPECIFIC VOCATIONAL PREPARATION - Amount of time required to learn the techniques needed for average performance of job duties.

6 - Over 1 year up to and including 2 years.
7 - Over 2 years up to and including 4 years.
8 - Over 4 years up to and including 10 years.

F. INTERESTS - Perferences for certain types of work activities or experiences.

1 - Situations involving a preference for activities dealing with things and objects.
9 - Situations involving a preference for activities that are nonsocial in nature, and are carried on in relation to processes, machines and techniques.
0 - Situations involving a preference for activities resulting in tangible, productive satisfaction.

G. TEMPERAMENTS - Work-situation adjustments required.

9 - Situations involving the evaluation (arriving at generalizations, judgments, or decisions) of information against sensory or judgmental criteria.
0 - Situations involving the evaluation (arriving at generalizations, judgments, or decisions) of information against measurable or verifiable criteria.

H. PHYSICAL DEMANDS - Physical demand activities required to perform job tasks

2 - Climbing and/or Balancing:
    (1) Climbing: Ascending or descending ladders, stairs, scaffolding, ramps, poles, ropes, and the like, using the feet and legs and/or hands and arms.
    (2) Balancing: Maintaining body equilibrium to prevent falling when walking, standing, crouching, or running on narrow, slippery, or erratically moving surfaces; or maintaining body equilibrium when performing gymnastic feats.
3 - Stooping, Kneeling, Crouching, and/or Crawling:
    (1) Stooping: Bending the body downward and forward by bending the spine at the waist.
    (2) Kneeling: Bending the legs at the knees to come to rest on the knee or knees.
    (3) Crouching: Bending the body downward and forward by bending the legs and spine.
    (4) Crawling; Moving about on the hands and knees or hands and feet.

H. PHYSICAL DEMANDS Con't.

4 - Reaching, Handling, Fingering, and/or Feeling:

(1) Reaching: Extending the hands and arms in any direction.
(2) Handling: Seizing, holding, grasping, turning, or otherwise working with the hand or hands (fingering not involved).
(3) Fingering: Picking, pinching, or otherwise working with the fingers primarily (rather than with the whole hand or arm as in handling).
(4) Feeling: Perceiving such attributes of objects and materials as size, shape, temperature, or texture, by means of receptors in the skin, particularly those of the finger tips.

6 - Seeing:

Obtaining impressions through the eyes of the shape, size, distance, motion, color, or other characteristics of objects. The major visual functions are: (1) acuity, far and near, (2) depth perception, (3) field of vision (4) accommodation, (5) color vision. The functions are defined as follows:

(1) Acuity, far - clarity of vision at 20 feet or more
Acuity, Near - clarity of vision at 20 inches or less.
(2) Depth perception - three dimensional vision. The ability to judge distance and space relationships so as to see objects where and as they actually are.
(3) Field of vision - the area that can be seen up and down or to the right or left while the eyes are fixed on a given point.

L. Light Work - Lifting 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. Even though the weight lifted may be only a negligible amount, a job is in this category when it requires walking or standing to a significant degree, or when it involves sitting most of the time with a degree of pushing and pulling of arm and/or leg controls.

M. Medium Work - Lifting 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs.

H. Lifting 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs.

I. WORKING CONDITIONS -- Physical surroundings of a worker in a specific job.

RESEARCH AND DESIGN
AUTOMOTIVE MECHANICS

Program Curriculum Objective

Goal: To provide students with the knowledge and skills to work as automobile mechanics.

Curriculum Statement: Our purpose is to develop a two-year course which, when completed, will enable the student to obtain a job as an automobile mechanic.

Curriculum Objective: Upon completion of four semesters in Automotive Mechanics, the vocational education student will have acquired the necessary skills and knowledge in automotive fundamentals and principles for the maintenance and servicing of passenger cars to become employable as an auto mechanic and apprentice mechanic, specialist mechanic, or small engine mechanic. Evaluation of automotive theory and principles will be measured by achievement of a minimum of 70% on multiple choice tests in the courses. Performance of required tasks must be at 100% proficiency according to manufacturer's specifications or shop manuals and in no longer time than that allowed in the Flat Rate Manual plus 40%. Evaluation will be done by the instructor. By successfully completing the additional courses with a C or better, the student may earn a certificate of achievement.

Performance Requirements:

1. The course must provide that students who complete it will be able to pass automotive theory tests with 70% accuracy and be able to perform the following tasks correctly, according to manufacturer's specification, in Flat-rate plus 40% (apprentice allowance) time:
   - a. Rebuild an engine
   - b. Repair or replace electrical system
   - c. Install and repair air conditioning system
   - d. Repair suspension system
   - e. Repair steering systems
   - f. Repair or replace brake systems
   - g. Repair or replace transmission systems, standard and automatic
   - h. Repair rear-axle assemblies
   - i. Diagnose trouble in all of the preceding and communicate orally and in writing understanding of the problem diagnosed and its proposed remedy.
2. The course will be designed in a series of blocks, corresponding to the above list, subdivided into appropriate units.
3. Evaluation of the methods and materials and instructional strategies will be based on learner performance in each unit by (a) learner achievement on theory tests, (b) learner's performance of assigned

tasks within each unit and block, (c) instructor's assessment of implementation.

4. Instruction will take place in the classroom and in the auto shop.

5. The total program will consist of twenty-four units in five courses with half of each course spent in lab (shop) work.

6. It is desirable for students to achieve proficiency by the end of four semesters.

7. In order to achieve a certificate of achievement, these other classes must also be completed with a grade of C or better:

   I ED 9
   I ED 10A
   I ED 5
   I ED 36
   I ED 60B (Math, problem solving)

#3 Learner Characteristics: The beginning automotive student at Fresno City College meets the district's entrance requirements and has no special skills or limitations. The average reads at ninth grade level and has seventh grade level math skills.

Additional characteristics derived from the Composite Summary of EOP students which are relevant to the objective are that the student:

1. attends college in order to become economically self-sufficient
2. may be bi-lingual
3. may have lower educational ability than average
4. may have lower English usage skills
5. may have lower mathematical skills
6. may have poor study habits
7. may be more spontaneous
8. may be higher in aggression
9. may be lower in self-confidence
10. may be lower in self-control
11. may be lower in personal adjustment.

Prerequisites:

1. Physical capability. The automotive student needs to be able to lift fifty pounds maximum with frequent lifting and/or carrying objects weighing up to 25 pounds. The student must be able to reach in any direction, to seize, hold, grasp, turn with hands. He must be able to pick up, to pinch and to work with fingers primarily as well as with whole hand or arm. He must be able to perceive objects and

their attributes such as size, shape, color, texture, temperature. He must be able to stoop, kneel, crouch and crawl.

2. General education level

   A. The student should be able to interpret the manuals used in automotive work as well as drawings and schedules. He should be able to file alphabetically and to record forms, checks, receipts, and bills. He should be able to copy data from one record or source to another. He should be able to learn his job duties from oral instructions or demonstrations; be able to write work orders and request parts or assistance orally.

   B. The automotive student needs to be able to perform simple math (addition, subtraction, multiplication and division), and to write and record figures. He must also be able to make arithmetic calculations involving fractions, decimals and percentages. He needs to be able to perform ordinary arithmetic, algebraic and geometric procedures in standard, practical application.

   C. The student needs to apply common sense understanding to carry out simple two-step instructions in detail, both oral and written. He should be able to deal with variables from the standardized situation. He must be able to read and follow diagrammatic instructions. He must be able to solve practical problems by application of rational systems. He must be able to interpret and combine instructions furnished in written, oral, diagrammatic, or schedule form.

3. Behavorial level. The automotive student, to succeed in the objective, needs:

   A. Willingness to follow directions, oral and written
   B. To initiate and follow a logical sequence of actions
   C. To find satisfaction in execution of correct procedures
   D. To desire to complete a job commendably
   E. To exhibit care of equipment and tools (neatness)
   F. To show carefulness and precision in performing operations
   G. To exhibit patience

RESEARCH AND DESIGN
AUTOMOTIVE MECHANICS

Automotive Mechanics 51

Course Objective for Engine Rebuilding Unit

By the end of one semester in AM 51, Engines, the learner will have assembled with tolerances according to manufacturer's specifications an automobile engine. The assembly will be done in the auto shop. It will be evaluated by the instructor's personal observation and inspection of the work itself, by appropriate practical test, and by satisfactory completion of projects outline on worksheets. The learner will also be able to pass a multiple choice test on engine theory with a minimum of 70% correct answers in the classroom.

RESEARCH AND DESIGN
AUTOMOTIVE MECHANICS

Automotive Mechanics 52

Course Objectives

AM 52A: Repair or Replace Electrical Systems and Fuel Systems

By completion of this unit in one semester, the learner will repair or replace a car's electrical system with 100% proficiency in accordance with manufacturer's specifications. He will pass a multiple choice test on electrical systems at a minimum score of 70% correct. Evaluation will be done of work by the instructor's observation of how well worksheets are followed and by his inspection of the work done. Work will be done in the shop; the test will be given in the classroom.

AM 52B: Repair or Replace Electrical Systems and Fuel Systems and Air Conditioning Systems

By the end of this unit, one semester, the learner can repair or replace the fuel system in an automobile. He can make corrections and adjustments in the fuel system parts and can tune an engine all to the standard set in the appropriate factory and service manual for the year and make of car. He can pass a multiple choice test on theory and diagnosis of fuel system operations with a minimum of 70% correct. The work will be performed in the shop and will be inspected by the instructor and evaluated for conformity to the factory and service manuals. The theory test will be given in the classroom.

AM 52C: Install and Repair Air Conditioning System

By the end of this unit, in one semester, the learner will be able to install an air conditioning system in an automobile according to appropriate factory manual at 100% proficiency. He will be able to diagnose and repair air conditioning systems. The work will be done in the shop and will be evaluated by the instructor's personal observation of how well job sheets are followed and by inspection and testing of the finished work. The student will also, in the classroom, pass a multiple choice test on the theory and operation of air conditioning systems at a minimum of 70%.

RESEARCH AND DESIGN
AUTOMOTIVE MECHANICS

Automotive Mechanics 53

Course Objectives

AM·53A: Repair Suspension System

By the end of this unit, in one semester, the learner can diagnose, repair, adjust, or replace steering and suspension systems' parts in an automobile 100% according to manufacturer's specifications. He will pass a multiple choice test on theory at 70% minimum. Work will be performed in the shop. The test will be taken in the classroom. Work will be evaluated by the instructor by personal observation of the student's performance and ability to follow worksheets and by inspection of the work to judge its conformity to manufacturer's specifications or to the appropriate service manual.

AM 53B: Repair or Replace Brake Systems

By the end of this unit, in one semester, the learner will be able to diagnose, adjust, repair, or replace brake systems in a car according to the appropriate manufacturer's specifications or service manual. He will pass a multiple choice test on theory of braking systems at 70% minimum, in the classroom. The work done in the shop will be evaluated by the instructor's observation of how well worksheets are followed and by inspection of the work and its conformity to the standards set in the appropriate service manual for that year and make, or in manufacturer's specification.

Automotive Mechanics 54

Course Objectives

Unit: Repair or Replace Transmission Systems, Standard and Automatic, Mechanical and Hydraulic Clutch Systems, Drive-Line, Differential, and Axles

By the end of this unit, in one semester, the learner will be able to diagnose, adjust, repair, or replace transmission systems; standard or hydraulic clutch systems; standard or hydraulic drive-lines; differential; and axles. The work performed will be 100% according to the appropriate manufacturer's specifications or service manual for the year and make of car or part. The work will be done in the shop and will be evaluated by the instructor's observation of how well the student follows work sheets and by inspection of work performed for conformity to the appropriate standards of the manual for that year and make of automobile. A multiple choice test on theory of transmission, clutch, drive-lines, differential and axles will be passed at 70% minimum, in the classroom.

Unit: Repair Rear-axle Assemblies

By the end of this unit, in one semester, the learner can diagnose, adjust, repair, or replace rear-axle assemblies at 100% proficiency according to the appropriate manufacturer's specifications or service manual for the year and make of automobile. The shop work will be evaluated by the instructor's observation of how well student follows worksheets and by inspection of the work for conformity to the manufacturer's specifications or service manual. A multiple choice test on theory of rear-axle assemblies will be passed at a minimum of 70% correct, in the classroom.

RESEARCH AND DESIGN
AUTOMOTIVE MECHANICS

#4-5 **Automotive Mechanics 60**

#4 Course Objective

By the end of the semester, the student will be able to perform previously learned skills at a higher degree of competency. The learner will be evaluated by the instructor's personal observation of the work. The learner will also be evaluated on the time it takes to perform the project, using the flat rate manual as the criteria. The learner will also pass a multiple choice test on the previously learned areas with a 70% minimum.

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

Terminal Mastery From Other Required Courses

1. Language and Communication (For Graduation, Not For Certificate)
    a. to read at ninth grade level
    b. to write enough to fill out job applications
    c. to copy numbers, part names, instructions accurately; to write down messages conveyed orally; to write messages on one's own behalf
    d. to understand spoken English and be able to respond appropriately and understandably

2. Mathematics (60B - Required)
    a. to perform simple math
    b. to write and record figures
    c. to make calculations involving fractions, decimals and percentages in standard, practical applications

3. Personal Health (Required For Graduation, Not For Certificate)
    a. to maintain personal health and stamina
    b. to keep personally clean and presentable

4. Human Relations (Ind. Ed. 39)
    a. to understand the objectives of others and be able to work cooperatively to attain them
    b. to exhibit self-respect as shown in attitude, manners, responsiveness to needs of others and to job requirements

5. Safety Education (Ind. Ed. 36)
    a. Positive steps which promote safety
    b. Behaviors to avoid
    c. Awareness of environment regarding safety factors
    d. Serious and responsible attitude toward safety

6. Basic Gas Welding
    a. the use and care of acetylene torch
    b. regulate oxygen
    c. types of steel
    d. sizes of welding rods
    e. principles of proper welding
    f. welding tip selection
    g. safety
    h. types of joints and welds
    i. physical properties of metals
    j. weldability of metals

k. identification of metals
l. welding of light gauge metals
m. brazing

7. Automotive Essentials (Ind. Ed. 9)

    a. safety
    b. hand tool identification
    c. theory and construction of engine
    d. service

8. Machine Shop (10A)

    a. principles of machine shop practice
    b. knowledge of cutting tools
    c. selection of cutting tools/speed
    d. safety with lathe operations
        1. turning straight taper
        2. threading, external and internal
        3. threading, right and left hand
        4. baring
    e. understanding dividing head
    f. setup milling machine

RESEARCH AND DESIGN

PROJECT: MOBILITY

STEPS OF CURRICULUM ANALYSIS

STEP 2

HAVING DEFINED THE REQUIREMENTS OF THE EMPLOYER AND RESTATED THE COLLEGE'S PROGRAMS IN PERFORMANCE TERMS; THE TEAM NOW SEEKS TO IDENTIFY WHAT EACH STUDENT MUST BE ABLE TO KNOW/FEEL/DO IN ORDER TO ACHIEVE THOSE OBJECTIVES. EACH COURSE OBJECTIVE IS ANALYZED TO IDENTIFY THE COGNITIVE/AFFECTIVE/PSYCHOMOTOR MASTERY EACH STUDENT MUST DEMONSTRATE TO SUCCEED. THIS ANALYSIS WILL PROVIDE THE TEAM WITH A DETAILED ENOUGH DEFINITION OF WHAT IS REQUIRED OF EACH COURSE TO SPECIFICALLY PINPOINT WHERE THE PROBLEM AREAS REALLY ARE.

STEP 2:

A) PERFORM A COGNITIVE/AFFECTIVE/PSYCHOMOTOR ANALYSIS OF EACH STATED COURSE OBJECTIVE TO DERIVE ALL HIGHEST LEVELS OF MASTERY REQUIRED FOR SUCCESSFUL COMPLETION OF THE COURSE.

B) STATE THE CRITERIA OF MASTERY FOR EACH ITEM IDENTIFIED IN THE COGNITIVE/AFFECTIVE/PSYCHOMOTOR ANALYSIS. THESE STATEMENTS WOULD INCLUDE THE METHOD OF EVALUATION AND THE LEVEL OF PERFORMANCE REQUIRED OF THE STUDENT (HOW AND HOW WELL). THIS STATEMENT IS NOT THE EXACT TEST ITEM THAT THE STUDENT WOULD ENCOUNTER (CRITERION MEASURE).

C) ASSESS EACH COURSE TO CONFIRM THAT THE SEQUENCING OF THE ITEMS OF MASTERY IS CORRECT ACCORDING TO THE TAXONOMIES; AND THAT THE COMBINED COURSES WILL PRODUCE THE MASTERY DEMANDED BY THE EMPLOYMENT REQUIREMENTS AND THE PROGRAM CURRICULUM OBJECTIVE (VOCATIONAL/OCCUPATIONAL COURSES ONLY).

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

AUTOMOTIVE MECHANICS 51: ENGINES

Elements of Required Mastery (Cognitive/Affective/Psychomotor)

Cognitive:

The student will know:

1. History and development of the internal combustion engine and of the automotive industry.
2. Characteristics of the various automotive engines manufactured.
3. The principles of operation of valves and valve action.
4. Design and function of crankshafts and main bearings and how to diagnose crankshaft and main bearing troubles.
5. Design and function of connecting rods.
6. Principles of cylinders, cylinder heads and crankcase design and function.
7. Design and function of the various types of engine block, such as the "Y" block and the "F" type.
8. The principles of automotive cooling systems; operations and design of water pumps, fans, thermostats, and anti-freeze chemicals.
9. The history of oil discovery and its development.
10. The meaning of viscosity, gravity testing, detergent, chemical soaps used in grease, and other terms used in petroleum processing.
11. Types of brake systems, operating principles and construction of the basic brake units.
12. How to diagnose engine troubles such as:
    a. Ways that an engine can use oil excessively.
    b. Causes of engine knocking.
    c. Oil pressure failure.
    d. Low compression.
13. How to estimate the cost of engine repair.
14. Where and how to obtain special services such as crankshaft grinding.
15. How to compute piston displacement, compression ratios and other problems using practical shop mathematics.

16. How to diagnose and repair basic brake and power transmission units.

Psychomotor:

The student will perform:

1. Service valve systems.
2. Use valve seat and valve refacing machines.
3. Use micrometers and other precision tools.
4. Check crankshaft for wear.
5. Check, adjust and align connecting rods.
6. Measure cylinder bores.
7. Fit piston rings and wrist pins.
8. Finish-grind pistons, using piston grinding machine as well as other special engine tools and fixtures needed in rebuilding an automotive engine.
9. Disassemble, inspect, assemble and adjust laboratory engines.
10. Disassemble, inspect, assemble, and adjust basic power transmission laboratory assembles.
11. Overhaul and test basic brake units.

Affective:

The student will appreciate the trade ethics and exhibit them. He will appreciate the dignity of labor and take pride in doing a job well. He will appreciate and participate in his responsibilities and privileges as as laborer, an employee, a citizen, or as a member of any organization for the benefit of any of the above.

1. He will exhibit willingness to follow directions.
2. He will observe safety rules and standards.
3. He will take care of tools and equipment.
4. He will be neat.
5. He will accept criticism.
6. He will show effort in his work.

AM 51: Elements of Required Mastery (Continued)

7. He will show interest in his work and its problems.
8. He will be punctual.
9. He will be personally clean and presentable.

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

AUTOMOTIVE MECHANICS 52: FUELS AND ELECTRICAL SYSTEMS

Elements of Required Mastery (Cognitive/Affective/Psychomotor)

Cognitive:

The student will know:

1. About the service rendered to man by the great inventors and scientists and the contribution they made to the automotive industry.

2. History of the development of electricity and of the scientists who contributed toward that development through their discoveries.

3. The function of the storage battery and its construction.

4. Causes of battery failure; how to test a battery; what tools to use for these purposes.

5. The principles of operation of automotive wiring systems:

   a. generator systems
   b. starting motors and starting motor control systems
   c. generator and generator control systems
   d. motor tune-up procedures and equipment needed

6. The general principles of carburetor operation, design and associated units, such as chokes, etc.

7. The principles of automotive wire systems.

8. The principles of electrical laws.

9. How to test the different storage batteries for serviceability.

10. The California State Motor Vehicle regulations on automotive lighting systems.

11. About headlamp output and adjusting machines.

12. How to read wiring diagrams.

13. Principles of operation of automotive starting systems.

14. How to test starting motor and starting motor control system.

15. How to test generator, generator control system, and what tools and equipment are needed.

16. Principles and function of the automotive ignition system.

17. Motor tune-up principles and equipment needed.

18. History of air conditioning.

19. Types of air conditioning systems.

20. Types of compressors.

21. The function and principle of expansion valves.

22. The function and principle of evaporators.

23. Use and operation of dehydrator receivers.

24. Principles and functions of condensers.

25. Coolant requirements.

Psychomotor:

What the student will do:

1. Service storage batteries.
2. Charge batteries.
3. Test and repair batteries.
4. Diagnose battery defects.
5. Diagnose and correct wiring system troubles
6. Install lighting accessories.
7. Read wiring diagrams.
8. Diagnose and repair starting motors.
9. Service charging systems - generators, alternators, control systems.
10. Service, repair, test, and adjust the ignition system.
11. Diagnose and repair carburetor defects.
12. Diagnose and repair intake manifold and heat control system.
13. Repair and adjust automatic chokes and other associate units.
14. Diagnose and repair fuel pumps, fuel filters, and fuel systems.
15. Check, test, repair emission control systems.

AM 52: Elements of Required Mastery (Continued)

16. Use equipment relating to fuel and electrical areas.
17. Clean and flush cooling systems.
18. Inspect, service, repair, or replace air conditioning system.
19. Diagnose problems and recommend their remedies in air conditioning system

Affective:

What the student must be:

Same as in other units.

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

AUTOMOTIVE MECHANICS 53: STEERING AND SUSPENSION SYSTEMS

Elements of Required Mastery (Cognitive/Affective/Psychomotor)

Cognitive:

What the student must know by the end of the unit:

1. Safety and shop rules and working regulations.
2. Procedures for planning work.
3. History of frame, front suspension systems, steering systems, and braking systems.
4. Types and constructions of frames.
5. Types, construction and operating principles of rear and front suspension systems.
6. Causes of excessive wear and normal wear of frames, front suspension systems, and steering systems.
7. Effects of excessive wear in any parts of suspension systems.
8. How to determine when parts are unfit for further use.
9. Geometry of the front end. Principles of front alignment.
10. Appropriate hand and machine tools for specific jobs.
11. How to trouble shoot front-end problems.
12. The oxy-actetylene welding and cutting processes, tools, and safety rules.
13. The California State Motor Vehicle Code on brakes.
14. Mechanical braking systems, parts and principle.
15. Hydraulic braking systems, parts and principles.
16. Power braking systems, parts and principles.
17. Know special brake equipment and tools.

Research and Design Project, Automotive Mechanics
AM 53: Steering and Suspension Systems

Psychomotor:

What the student must be able to do:

1. Operate common types of test equipment machines in a safe manner.
2. Use appropriate hand and machine tools with reasonable degree of skill.
3. Read detailed drawings, prints, and plans
4. Repair frames, straighten and align frames.
5. Use different types of wheel balancers.
6. Clean, inspect, lubricate and adjust wheel bearings.
7. Service springs and shackles.
8. Balance wheels.
9. Align wheels.
10. Adjust steering gear
11. Check, remobe and replace shock absorbers.
12. Inspect, remove and install tie rods.
13. Inspect, adjust and replace torsion bars.
14. Inspect ball joints and determine manufacturer's spects.
15. Check suspension for worn or loose parts.
16. Use torsion bar height gauge.
17. Check alignment between front and rear wheels.
18. Check and adjust castor, camber, and toe in.
19. Replace worn parts and realign according to manufacturer's spects.
20. Test brakes.
21. Use brake testing machines.
22. Adjust brakes.
23. Reline brakes.
24. Overhaul hydraulic systems.
25. Check, change, add brake fluid.

26. Overhaul power brake system.
27. Use break drum turning and brake drum lathes.
28. Diagnose brake trouble.

Affective:

Same as other units.

AUTOMOTIVE MECHANICS 54: TRANSMISSIONS AND DIFFERENTIALS

Elements of Required Mastery (Cognitive/Affective/Psychomotor)

Cognitive:

What the student must know:

1. History of automotive transmissions, clutches, torque converter and rear axles.
2. Trade safety practices and working regulations.
3. Types, construction, and operating principles of transmissions.
4. Types of clutches, construction, and operating principles.
5. Causes of excessive wear and normal wear of the automotive transmissions, clutches, and rear axles.
6. Diagnosing and testing of transmissions, clutches, and axles.
7. Diagnosing and testing of differentials.
8. Diagnosing and testing of drive-lines.

Psychomotor:

1. Operate common types of test equipment and machines in a safe manner.
2. Use hand and machine tools with a reasonable degree of skill.
3. Identify materials and parts used in automotive transmission, clutches, differentials, drive-lines, and axles.
4. Repair automotive transmission, clutches, differentials, and rear axles with acceptable conformity to manual and to manufacturer's specifications, and finish work before end of semester.
5. Read detailed drawings, prints and plans.
6. Analyze, test and adjust parts using correct equipment with acceptable conformity to manual or to manufacturer's specifications and within reasonable time.
7. Recognize parts unfit for further use.

AM 54: Elements of Required Mastery (Continued)

Affective:

What the student must be:

1. Able to work in harmony with others.
2. Appreciative of trade and fellow workers.
3. Appreciative of responsibility to employer and community.
4. Aware of necessity for careful, skillful and conscientious work.
5. Impressed with need to observe safety procedures.

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

AUTOMOTIVE MECHANICS 60: AUTOMOTIVE PROJECT LABORATORY

Elements of Required Mastery (Cognitive/Affective/Psychomotor)

Cognitive:

Same as for Automotive Mechanics 51, 52, 53, 54.

Psychomotor:

Competency, accuracy, and speed are the same, but learner is aiming toward flat rate manual time, plus 40%.

Affective:

Same as for Automotive Mechanics 51, 52, 53, 54.

RESEARCH AND DESIGN
PROJECT: MOBILITY
STEPS OF CURRICULUM ANALYSIS
STEP 3

USING THEIR COMPLETED COGNITIVE/AFFECTIVE/PSYCHOMOTOR ANALYSIS AND CHARACTERISTICS OF THE TARGET STUDENTS FROM THE NEED ASSESSMENT AND THEIR PAST EXPERIENCE, THE TEAM ASSESSES EACH ELEMENT OF REQUIRED MASTERY TO IDENTIFY WHERE THE STUDENTS ARE ENCOUNTERING PROBLEMS. THEY ALSO IDENTIFY NON-CONTENT RELATED PROBLEM AREAS.

HAVING PINPOINTED AN AREA, IT IS FURTHER ANALYZED TO IDENTIFY WHAT FACTORS ARE CONTRIBUTING TO THE CREATION OF THE PROBLEM. THESE WILL BE THE PROBLEMS THAT THE TEAM WILL FOCUS THE REST OF THEIR EFFORTS ON SOLVING.

STEP 3:

DETAILED INSTRUCTIONS PROVIDED TO THE TEAM FOR STEP 3.

A) IDENTIFY THOSE ITEMS OF MASTERY REQUIRED IN EACH COURSE WHICH REPRESENT PROBLEM AREAS FOR THE DISADVANTAGED STUDENT; I.E., REQUIRED PROFICIENCY LEVELS NOT BEING ATTAINED.

B) DIAGNOSE/IDENTIFY THE NATURE OF THE PROBLEM AREAS AND THEIR PERCEIVED CAUSES FOR PERFORMANCE DEFICIENCIES IN TERMS OF 1) STUDENT RELATED AND 2) CURRICULUM/COURSE RELATED CAUSES.

C) PRIORITIZE THE IDENTIFIED PROBLEM AREAS ACCORDING TO THEIR CRITICALITY FOR CONTINUING SUCCESS BY THE DISADVANTAGED STUDENT.

RESEARCH AND DESIGN PROJECT

Identification of Problem Areas

Instructions For The Completion of Overall Step 3

Operational Definition

Problem Area for the Disadvantaged Student: those areas in the curriculum which consistently present problems to disadvantaged students as a group, rather than to a single individual, which cause any of the following:

a. failure to achieve required mastery proficiency for course/curriculum

b. difficulty in achieving one or more mastery skills or a continuum of skills in a course

c. inability to complete course or curriculum (drops out)

d. the requirement for instructional support beyond that normally provided for students.

Steps To Be Performed

1. Compare course mastery skills with Job Entry requirements in Cognitive/Psychomotor/Affective domains.

   List job entry requirements not presently taught in courses.

2. Assess each mastery item stated for the course and identify any mastery skill within which disadvantaged students encounter academic or content problems in the three domains, per the operational definition, and personal experience.

   Note: If disadvantaged students drop out of curriculum during or following the basic course, and heretofore have not enrolled in higher courses, in analyzing the higher level courses, identify those areas which do present problems to normal students. Rationale: If normal students have problem areas, it can be anticipated that disadvantaged student who remain in the program will encounter similar or worse problems.

   Divide a page into three columns. In the left column, list the identified problem areas in mastery skills.

3. Diagnose/Identify the nature of the problem areas and their perceived causes in terms of critical incidents, personal experience or existing data as related to student related causes or instructional/learning related problems. (See the following for examples.)

   a. Student related causes: List these in center column of page next to mastery problem identified in left column.

Examples:

1. Lack of prerequisite skills required of the mastery skill. (Specify exact skills.)

2. Inability to cope with the reading requirements. (Specify student level of reading, or required level.)

3. Personality or emotional factors. (Cite as related to curriculum, or specific incidents.)

4. Cultural differences. (Cite as related to curriculum or skill mastery.)

5. Cannot transfer knowledge learned in "lecture" to application/psychomotor. (Specify exact nature of failure.)

6. Cannot master cognitive criteria but learns in the lab with oral instructions.

7. Cannot relate "lab" experiences to classroom theory or principles.

8. Any others you might cite.

b. Instructional related causes: List these in the right column opposite mastery problem.

Examples:

1. Learning steps too large for student.

2. Materials (quantity or level) used are beyond abilities of students.

3. Methods of instruction do not match learning styles of students.

4. Failure to build continuum of levels according to taxonomies, i.e., jumping from recall to application, or requiring students to analyze without lead-up learning in comprehension and transfer to application, etc.

5. lack of facilities/equipment.

6. no special services to be responsive to specific needs of group of learners or individuals.

7. any others you might identify.

4. Identify any additional problem areas you know to exist which are not tied directly to an academic mastery skill, i.e., sociological, cultural, emotional, etc.

   These might act as cues which will lead to the identification of areas in the curriculum requiring modification or expansion, or to services which can be provided such learners through counseling/ guidance, etc.

   List problem areas in this category.

5. Prioritize problem areas: The points of reference for this step are the three lists that you have produced

   --Job Entry Requirements not presently taught in courses
   --Academic or content problem areas for mastery in courses
   --Additional problem areas in non-academic category

   a. As a first step, inspect each item on each list and, through concurrence by committee members, determine whether the item would be grouped under the following categories:

      1. Problems which can be handled within the instructional program for which you are responsible

      2. Problems which are academically oriented, but not part of your normal courses, but related to other disciplines

      3. Problem areas for which special services might be provided outside of the instructional program.

      As you are performing this analysis, start a separate list of problem areas recommended for handling by other disciplines of instruction or for special services.

   b. For those problem areas which are within your instructional programs or mastery skills in the courses, reach concurrence by committee members as to the priority order in which problem areas should be solved, considering the following factors:

      1. Criticality of the problem mastery skills to continuing or following skills in the course

      2. How failure to master a particular skill contributes to overall achievement of course objective and criteria

      3. Criticality of mastery of cognitive content before transfer to application or psychomotor

4. How mastery of problem areas in the basic course carries over to higher level courses (i.e., will achievement in the basic course reduce problems identified in following courses, or are problems in higher courses related to the specific content in those courses?)

5. Importance of success in mastery of cognitive and psychomotor skills in reducing problem areas in the affective domain

On the list of problem areas for mastery in courses, number the items in priority order.

COURSE TITLE: ____________________

PROGRAM (VOCATIONAL/OCCUPATIONAL AREA): ____________________

IDENTIFICATION OF PROBLEM AREAS AND SOURCES OF PROBLEMS

Problem Areas for Students	Sources of Problems		
	Student Related Causes	Instructionally Related Causes	Sociological/Cultural Causes

AM 51

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
General Problems: Enter AM 51 without IE 9, Introduction to Automotive Essentials	Students must keep notebook, diagrams, etc., write terms, define terms, etc.: may not be able to take notes.	Many have a problem in comprehension of principles of electricity; therefore IE 11 has been made a requirement for the certificate program		
Ones who are required to repeat classes: school accepts "D" as passing, but AM will not recommend students for jobs if they do not achieve a "C" in courses	Student must recall a variety of data (water expansion, properties of coolants regarding types of engines, pressure caps)	Students have trouble applying lecture information to lab situation; possible lack of attention/comprehension/recall in lecture situation		
Financial: must furnish engines & parts (overhaul engine costs about $300; can recover costs after rebuilt and sold) Could cause some drops	Requires memorization of terminology: can help recall by referring to his notebook	Students need more individualized help and reassurance when working on machines		
Means of identifying disadvantaged: 1. Identifying reading problems: Reading at level of textbook. 2. Math--would not be problem if they took IE 60 Math before entering 51	Requires application of logical thought processes (induction, deduction) and reading Must remember: 1. basic engine operation 2. internal combustion theory 3. specific engine needs & difficult mechanical manoeuvres	Sometimes students must wait to use a machine (i.e., dial indicator)		
Students are placed in programs as a place to put them rather than interest	Failure to distinguish between angle-stones			

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
	Failure to consult books (manual, etc.) when needed Problems in interpretation of micrometer readings			
Cognitive				
Safety=100% Criteria (90% pass first try, 10% do not pass: cannot go into shop without 100%; usually pass after 2nd or 3rd try)	Reading, understanding of rules & terminology Attention span, ability to listen Miss first day of class Writing words or fill-in items 7th grade reading level Do not believe accidents can happen to them Failure to take notes; inability to take notes	1 or 2 periods are devoted to booklet instruction Instructor does not know who is having trouble with terms/reading until test is given Lecture format with equipment demonstration Book lists rules, instructor explains/demonstrates; book does not explain why Book requires memorizing Notebooks		
Design & Function of: Crankshafts Mainbearings Diagnose Crankshaft & mainbearing troubles	Diagnosis: Identify noises & identifying sources Measuring crankshaft & bearing clearance with micrometer (how to read & measure with & write numbers) Problems in reading Failure to do notebook Lack of initiative to make up missed notes or go for help	Might not have an engine making appropriate noises Texts at 9th grade level Notebooks witn details Notebooks checked four times a year Micrometer explained No special services to provide catch-up instruction or repeat		
Design & Function of Connecting Rods, Piston Pins, Rings	Failure to diagnose & measure with micrometer, thickness gauges			

AM 51

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Principles of Cylinders, Etc.	Same as above Measurement Thickness gauges Problems in reboring Might not be able to explain process & then use it Reluctant to try if they do not understand			
Principles of Operation of Valves and Valve Action	Failure to understand or apply basic knowledge of engines to: valve timing valve overlap firing order	Not enough time to teach all students all material		
Principles of Water Expansion, Properties of Coolants Regarding Types of Engine Pressure Caps	Failure to recall variety of data as needed			
How to Diagnose Engine Troubles	Same as above			
How to Estimate Cost of Repairs	Difficulty in using shop manual	Reading and book usage is not taught		
How to compute piston displacement, compression ratios	Difficulty in working math problems	Math is not taught in class		
How to Position Distributor	Retention of lecture until lab time			
Characteristics of Various Auto Engines Manufactured	Failure to identify different types of engines Inability to remember or retain terminology after instruction	Instruction might be too fast because of time element Cover 17 chapters and answer questions in chapters		

AM 51

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
	Unable to read 9th grade level or else do not do reading assigned			
	Inability to explain operations in writing or orally	We assume inability to explain equals failure to comprehend		
	2 operations done simultaneously with 2 hands (grinding valves)			
	Reluctance or errors in using shop manual			
	Putting distributor in right position			
	Failure to measure correctly			
	Holding part correctly			

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
	Retention Cannot read or read too slow Financial aid students have to take 12 unit load, which cuts study time	Text might be above reading level Do not have all engines on hand, but there are pictures in books No special services or tutoring for these students: advise that better students tutor slower ones		
Principles of Operation of Internal Combustion Theory	Projecting cycles of revolutions of the engine Might not know degrees of circle: 2 revolutions = 720° Solving problems in piston position	Same as above Do test problem solving, but work few on board; finish as homework Orally confirm in class		
Design and Function of Engine Blocks: V and F Types	Same as problems under "Characteristics of Various Auto Engines Manufactured"	First formal unit test except for Safety and Micrometer tests (includes tests on tools)		
Psychomotor				
Valves and Valve Action Problem Solving Involving Math Using Dial Indicator Making a Paper Gasket	Difficulty learning terminology, memorizing terms & names of things Failure to distinguish between angle-stones Failure to consult notebook manuals when needed Applying lecture information to lab situations Failure to retain information (water expansion, internal combustion theory)	Pace too fast: 90% lectures before or by mid-semester (17 chapters per semester) Tests above reading level of some; steps too large Lack an F-head block Tutoring not satisfactory as Center wants to use good AM students as tutors. They aren't good enough, don't want to spend time	Failure to consult instruction manual may be cultural	

AM 52

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Basic Fundamentals of Electricity	Failure to grasp principles (too abstract)			
Storage Battery	Failure to comprehend the chemical/electrical process	Learning steps too large; hence IE 11 has been made a prerequisite		
Operation of DC Generator, Etc.	Failure to remember difference between A and B circuit. How to polarize it	Constraint on instructor to keep up pace for successfully learning students		
Operation of Alternator, Etc.	Same as above	Need more repetition & reinforcement		
Starter & Starter Control	Fundamentals of electric motor are not clear	Need more repetition & reinforcement		
Operation of Ignition System	Failure to understand or retain how system works (when points open is when spark occurs)			
Operation of Transistorized Ignition	Same as above	Requires translation from conventional to transistorized system		
Following wiring diagram	Ability to read diagram; ability to visualize from schematic			
Using Scope & Infra-red Exhaust Gas Analyzer	Relating scope waves/patterns to their meanings (identifying abnormality)	Lack of time & equipment so each student can have this experience. Also, some students only get to use these long after pertinent lecture-teaching		

AM 52

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Emission Control	Reading problem regarding use of manuals; also failure to transfer	Manuals are difficult to understand		
Operation of Fuel System (Carburetor, Etc.)	Difficulty understanding the circuits			
Diagnosis of Complete Fuel System	Remembering principles, applying knowledge, using reason/logic to arrive at solution of problem; process of elimination	Possible insufficient drill in problem solving		
Air Conditioning Unit: How Systems Are Controlled	Confusion about different types of controls (GM, Frigidaire, Chrysler, etc.) Failure to review enough or to read textbook	Lack of experience opportunities to reinforce		
Psychomotor				
Diagnose Battery	Think: problem solving			
Diagnose Wiring System Problems	Same as above			
Tune-Up	Spark plugs hard to get out Assembling a carburetor Manual dexterity Getting threads set on a brass fitting			

AM 53

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Planning Work	Wants to skip book work			
Wheel bearings (types) Tires (types, construction)	Lack of experience	Insufficient reinforcement		
Wheel alignment, basic angles	Difficulty learning terminology Failure to consult manuals Difficulty in thinking & acting simultaneously	Insufficient repetition with real examples	Don't read as a matter of course; tend to avoid reading	
	Retention of information Relating data to practical situation	Practice in analytical skills		
Suspension diagnosis	Difficulty interpreting symptoms Difficulty calculating Don't keep notebooks	Worksheets need finer steps, greater detail		
Steering Diagnosis	Failure to recognize parts Failure to follow measurements, charts in manual			
Brakes	Failure to use simple math correctly			
Not Having Had IE 9 (Automotive Fundamentals)				
Student and/or Others Actually Endangered by Failure or Inability to Observe Safety		Student needs to be inventive		

AM 53

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Inability to Buy Parts, Engine to Work on ($350)				
Inability of 10% to Pass Safety Test				
District Recruits Students Who are Unrealistic About the Demands, Prerequisites, Etc. of Classes. Some Auto Students Do Not Expect or Wish to Learn from Lecture or Books. They Do Not Intend, Expect or Want to Read Books, Write Note-Books, Take Tests				
No Restrooms in Shop Area				
No Aides to Allow for Individualized Attention (Classes Are Too Large)				
Students Sometimes Want Only Units or Time for Bucks (Federal Checks) No Intention of Learning				
Part-time Instructors Some-Times Are Not Good				
Time Does Not Allow Every-one to Practice Everything				

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Identifying Clutch Parts	Failure to distinguish between types of clutches & parts	Students need more experiences		
Recognizing Parts Unfit for Use	Application of book knowledge	Students need more experiences		
Tool Selection		Too brief acquaintance; each manufacturing requirements different		
Torque & Gears; Gear Ratios	Comprehension of gear ratios. Deficient math skills (add, subtract, multiply, divide, decimals)	General math not intensive enough: needs to be specific for auto specific problems		
Fluids for Use In Transmission	Understanding need for different manufacturers; why not interchangeable			
Fluid Coupling and Torque Converter	Understanding the principle (leverage)	Hard to show, to see, to demonstrate		
Hydraulics	Math (basics)			
How Planetary Gear Works		Too hard to make visual presentation (needs 3 dimension, not just 1)		

AM 54

Problem Area for Student	Student Related Causes	Instructional Learning Causes	Sociological/Cultural Causes	Solutions
Diagnosing Auto Transmission: Fluid, Noise, Slip	Needs more experience, confidence			
Construction of Rear Axles; Differential Speeds		Same as "Fluid Coupling"		

RESEARCH AND DESIGN

PROJECT: MOBILITY

STEPS OF CURRICULUM ANALYSIS

STEP 4

NOW THAT THE TEAM HAS PINPOINTED EXACTLY WHERE THE TARGET STUDENTS ARE ENOUNTERING PROBLEMS AND THE FACTORS CREATING THE PROBLEMS, THEY WILL TURN THEIR ATTENTION TO SOLVING THOSE PROBLEMS.

SOLVING THE PROBLEMS WILL INVOLVE THE SELECTION OR DEVELOPMENT OF NEW METHODS AND MEDIA OF INSTRUCTION, NEW PROGRAMS AND NEW SERVICES, ALL TAILORED TO THE UNIQUE NEEDS OF THE TARGET LEARNERS. BEFORE THE TEAM CAN MAKE THESE KINDS OF DECISIONS, HOWEVER, THEY MUST MORE SPECIFICALLY DEFINE THE EXACT NATURE OF THE MASTERY REQUIRED AND THE CRITERION OF MASTERY FOR EACH OF THE CONTENT PROBLEM AREAS. THIS WILL GIVE THEM ALL THE DATA THEY REQUIRE TO BE SURE THE CHANGES THEY RECOMMEND WILL BOTH GIVE EACH STUDENT THE SKILLS/KNOWLEDGES/ATTITUDES REQUIRED FOR EMPLOYMENT AND BE RESPONSIVE TO THE LEARNERS' NEEDS. THE METHODS/MEDIA RECOMMENDATIONS IDENTIFIED AT THIS STEP WILL BE COMBINED WITH THE RECOMMENDATIONS THAT WILL COME FROM STEP 5. IN COMBINATION THEY WILL CONSTITUTE THE TEAM'S SOLUTIONS TO THE PROBLEMS IDENTIFIED.

STEP 4:

DETAILED INSTRUCTIONS PROVIDED TO THE TEAM FOR STEP 4.

A) RESTATE THE PRIORITY PROBLEM AREAS AS TERMINAL PERFORMANCE OBJECTIVES.

B) DERIVE CRITERION MEASURES FOR EACH TERMINAL PERFORMANCE OBJECTIVE.

C) ANALYZE THE LEARNING REQUIREMENTS TO ACHIEVE EACH OBJECTIVE.

D) ORGANIZE THE LEARNING STEPS.

E) ANALYZE ALTERNATIVE METHODS AND MEDIA.

RESEARCH AND DESIGN PROJECT

Development of Mastery Skills Identified as Priority Problem Areas

Instructions For The Completion of Overall Step 4

As a result of the identification of problem areas for disadvantaged learners in the mastery skills for each course, the faculty analysts will have made decisions as to the following:

1. Those problems which can be handled within the instructional/learning environment of the special areas' curriculum;
2. Those problems which should be handled either by
   a. other subject matter specialists (example, reading, math, others)
   b. special support services (example, counseling, guidance, psychological, placement, etc.).

Priorities for development will have been established also.

The procedures listed below are those which will be performed by the faculty to develop learning sequences and solutions for learning problems which can be handled in the instructional/learning environment (#1 above). Other problems will be referred to appropriate groups.

Throughout the procedure, itemized below, references will be made to portions of the SAFE manual, Designing For Predictable Learner Success--the manual used in the training sessions. The faculty analyst might reread the referenced sections for explanation, examples, processes and forms.

SUGGESTION: A more productive and efficient use of the faculty time might result in assigning each member of the team a different problem mastery skill for development, applying the following steps. Group concurrence might be reached in the individual products, periodically. In this manner several products might be developed in the time that it would take the group to produce one.

STEP 1. Restate the Problem Mastery Skill as a Terminal Performance Objective.

Reference: SAFE manual, pages 161-178, "Deriving and Stating Terminal Performance Objectives (T.P.O's)." Also see pages 61-78, "Criteria for the Writing and Critique of Performance Objectives."

Refer to the statements in the course mastery analysis (cognitive/psychomotor/affective). Add the elements to this statement which will expand it into a well stated learning objective, as specified in SAFE manual.

Refer also to the criterion measures identified in the mastery analysis for the evaluation portion of the objective.

Write objective in left column of Form I-2.

STEP 2. *Derive Terminal Performance Criterion Measures.*

Reference: SAFE manual, pages 179-199.

If you did not state criterion measures during mastery skill analysis, develop them now from the Terminal Performance Objective.

Some groups already performed this step when identifying the criterion measures in the course mastery skill analysis (criterion levels and specific test items).

However, since you have performed further analysis of the mastery skills during problem identification, you might have generated further data or gained other insights regarding learning proficiency. It is suggested, therefore, that you review the prestated criteria to determine the following:

a. Whether the level of proficiency is still acceptable or should be increased or decreased;

b. Whether the criterion measures or test items are valid measurement of achievement of the objective to indicate mastery;

c. Whether the present method of evaluation is still suitable or whether alternate methods of evaluation with the disadvantaged population might yield the data required for evaluation;

d. Whether additional items must be added or existing items deleted or changed so that the evaluation instrument or activity measures all aspects of mastery.

Your expertise and your problem identification analysis statements will be the basis for these judgments.

If changes are required, make them at this point.

In the second column of Form I-2, "Criterion Statement," list the conditions of evaluation.

In the third column of Form I-2, write in the items and instructions given to the student in the testing condition.

a. If questions on a final exam are used for evaluation, include only those items which measure this objective.

b. If a unit test is to be used, the test might be stapled to the form.

c. If evaluation is performance of psychomotor skills or activities, list the instructions given the student.

STEP 3. *Analysis of Learning Requirements to Achieve Objectives.*

Reference: SAFE manual, pages 201-219, Taxonomies Handout, and pages 145-146.

Using Form J-2, analyse the lead-up content (cognitive), skills (psychomotor), behavior (affective) required for achievement of the T.P.O.

Those groups who used course content outlines for identifying mastery skills will have a start on this step. The subtopics on the outlines might represent lead-up knowledge/skills. However, you might determine whether these should be expanded to give you all the required data for learning related to the T.P.O.

In doing this analysis, the reference is the disadvantaged learner.

1. Identify first what level in the taxonomy represents mastery.
2. Analyse from the learner's entry level* and from what the learner needs to know and do to build all elements of mastery.

   *Entry level refers to what they have mastered from previous learning sequences or courses.
3. Refer to the taxonomies to determine what lead-up activities and levels the learner must achieve on a continuum from simple to complex.

   Remember--do not leave out learning levels.

   --they must learn and practice the mastery level before evaluation; i.e., if they must analyse, do not expect to give learning experience in recall, comprehension, and application and then expect them to analyse. They must also have learning experience in analysing or must learn how to analyse.

The columns on Form J-2 will give you cues.

STEP 4. *Organize Learning Steps/Sequence.*

Reference: SAFE manual, pages 277-299.

a. Using Form K-2, organize the learning requirements from the Cognitive/Psychomotor/Affective Analysis (Form J-2, 3) into the actual learning step sequence the learner will perform to achieve the objective.

Note: *This might be in the order you stated in the analysis or you might want to schedule several recall activities or comprehension activities before application (for example).*

Enter sequence in the left column of Form K-2.

b. As you are sequencing the learning steps, determine the response desired from the learner and whether this will be evaluated. Enter these in the second column of Form K-2.

STEP 5. *Method/Media Analysis.*

Reference: SAFE manual, papes 305-329.

a. Using the Decision-Making Model on page 312, SAFE manual, perform a method/media analysis on each learning step or a sequence of learning steps to determine the requirements based on the nature of the learning activities. This analysis can be performed quickly once you practice using the Decision-Making Model.

b. In Column 3, Form K-2, list the methods/media alternatives which can be used for the learning step or a sequence of steps. The alternatives might be those which you know about now. You might also wish to investigate others which are available in the Media Center or which are commercially available--both of which can be screened to determine if they meet the requirements for your population. Another possibility is that the Media Center might develop something, if nothing exists to meet your requirements.

In the last column, indicate your recommended selection, or final selection can be made during the management planning step.

FORM I-2

ACTUAL SIZE 8½" X 14"

TERMINAL LEARNING REQUIREMENTS

Curriculum ______________________________

Course/Unit Title ________________________

Curriculum Analyst ______________________

Date ____________________________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No.	No.	No.

ACTUAL SIZE 8½" X 14"

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

Course/Unit: ____________________

T.P.O # ____________________

Level of Mastery: ____________________

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)

ACTUAL SIZE 8½" X 14"

FORM K-2

LEARNING SEQUENCE

Course/Unit:____________________

T.P.O. # ____________________

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION

FORM I-2

Curriculum A.M. 51

Course/Unit Title Safety Unit #1

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ______________________

Date ______________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 1 At the end of the unit, the student will be able to pass the safety test with a score of 100%.	No. 1 The student must have 100% correct answers on the safety test. Student cannot enter shop class until test is passed. Test may be retaken until passed.	No. 1 The student will have 50 minutes to write his test answers.

FORM J-2

Course/Unit: A.M. 51

T.P.O # 1 Safety Unit

Level of Mastery: #1

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
	Need for stress on safety.				
Electrical dangers.	How to use electric power safely.				
Types and uses of fire extinguishers.	How to avoid fires.				
Methods of good housekeeping.	Eye safety.				
Principles in lifting and bending.	How to lift safely. How to place work for safety.				
Chemical dangers.	How to store and use chemicals.				
Mechanical hazards.	How to avoid injury to self or to materials by machines.				

FORM K-2

Course/Unit: A.M. 51

LEARNING SEQUENCE

T.P.O. # 1 Safety Unit

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA New Ways to Support Instruction	METHOD/MEDIA SELECTION
See J-2.	Take test following instruction at comprehension level.	Require oral evaluation and feedback from each student prior to administering test. Demonstration of results of bad safety practice (film?, film strip?). Safety film specific to auto shop. Have a human-type dummy to use to demonstrate consequences of carelessness in auto shop.	Safety films specific to auto shop available to students for individual viewing: an "how-to-be safe" to reinforce concepts on test. An animated film which shows what may happen if safety rules and precautions are ignored or violated in the auto shop.

FORM I-2

Curriculum A.M. 51
Course/Unit Title #2 Tool Unit

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst
Date

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 2	No. 2	No. 2
At the beginning of laboratory work, the student will be able to identify the tools needed to rebuild an engine and understand their use.	The student will be able to identify 90% of the tools needed in engine rebuilding by showing recognition, naming the tool and its function.	Pass a MCT on tools' use at 70%. Pass an identification test at 90%. Instructor points to a random selection of shop tools and student must name 9 out of 10.

FORM J-2

Course/Unit: A.M. 51
T.P.O # 2 Tool Unit
Level of Mastery: ____________

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
What tool looks like. Categories and functions of tools. Size gradations of wrenches and sockets. Different kinds of threading. Thickness of gauges and how to use. Power tools. Specialized tools Student learns wrench/socket sizes and gradations. Student learns different kinds of threading.	what it is used for. Importance of using correct tool (dangers of wrong ones). How to use tool. Look at bolt head; measure visually; select right wrench or socket for bolt head. Explain different types of tools and their differences. Check estimated sizes by measuring. How safety measures protect.				

FORM J-2

Course/Unit: A.M. 51
T.P.O # 2 Tool Unit
Level of Mastery:

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Student learns which tools are used to measure, which to cut, which to turn, hold, lift, bend etc. Student learns what power driven tools are used in auto shop and for what job. Safety measure.					

FORM K-2

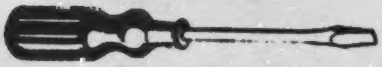
LEARNING SEQUENCE

Course/Unit: A.M. 51

T.P.O. # 2 Tool Unit

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
	Student names tool when asked; explains function.	Film or film strips showing tools and their uses.	All of those listed under Alternate Methods/Media.
	Student selects correct tool	Make a board to hang by tool room with bolt-heads on it. Student must measure sample and compare to his own need before requesting a wrench, socket, or thread-type tool.	
	Student explains significance of threading to tool selection.	Build a board game which students can use to sharpen recognition of sizes and threadings.	
		Make (invent) a pocket-sized measuring device to aid students in selection of tools. It needs to measure a) bolts, b) screws, c) holes.	

FRESNO CITY COLLEGE
AUTO MECHANICS 51
HAND TOOL QUIZ



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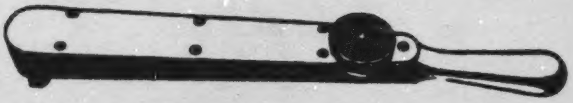

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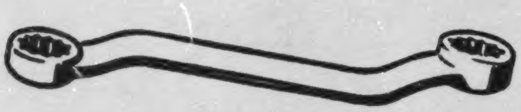

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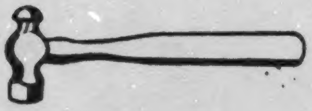

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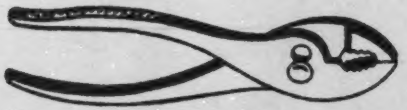

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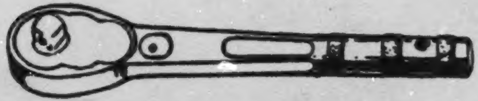

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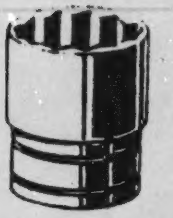

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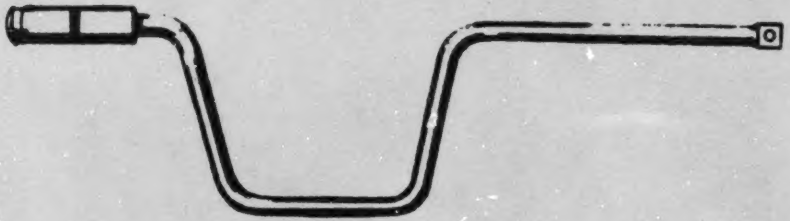

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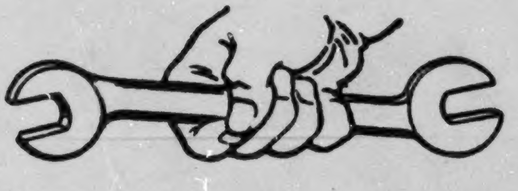

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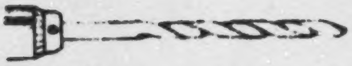

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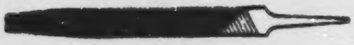

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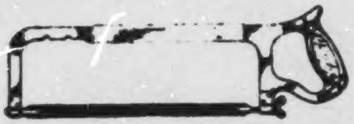

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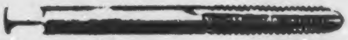

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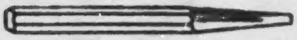

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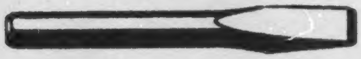

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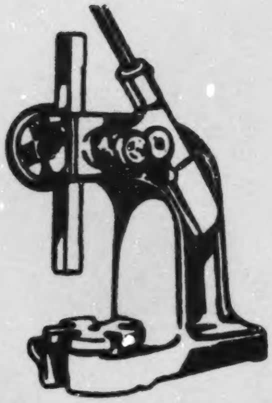

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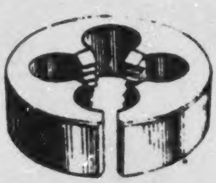

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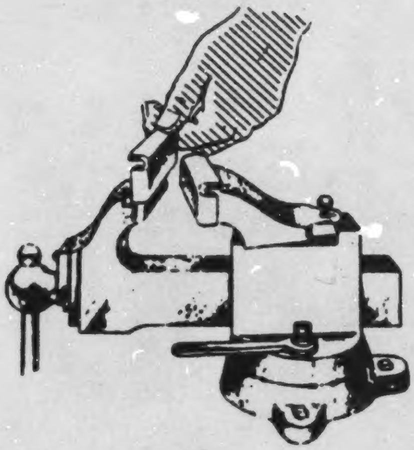


18. ____________

19. THE MOST COMMON AUTOMOTIVE-SHOP HAMMER IS:
    A. THE BRASS HAMMER
    B. THE CLAW HAMMER
    C. THE BALL-PEEN HAMMER

20. THE MOST COMMON SCREWDRIVER USED IN THE AUTOMOTIVE SHOP IS THE KIND USED TO DRIVE:
    A. PHILLIPS-HEAD SCREWS
    B. SLOTTED-HEAD SCREWS
    C. HEX-HEAD SCREWS

21. DRILLS, OR TWIST DRILLS, HAVE:
    A. SEVERAL CUTTING EDGES
    B. TWO CUTTING EDGES
    C. ONE CUTTING EDGE

22. A MAJOR DIFFERENCE BETWEEN THE BOX WRENCH AND SOCKET WRENCHES IS THAT THE SOCKET WRENCH:
   A. REQUIRES A SEPARATE HANDLE
   B. IS LARGER
   C. HAS MORE NOTCHES IN THE HEAD

23. DIRTY OR BATTERED SCREW THREADS CAUSE THE TORQUE REQUIRED TO TIGHTEN A BOLT TO:
   A. INCREASE
   B. DECREASE
   C. STAY THE SAME

24. THE PURPOSE OF USING A FILE HANDLE WITH A FILE IS:
   A. TO KEEP FROM BREAKING THE FILE
   B. TO KEEP FROM DULLING THE FILE
   C. TO PROTECT YOUR HAND

25. A HACKSAW BLADE WITH HOW MANY TEETH PER INCH IS RECOMMENDED FOR CUTTING THIN TUBING?
   A. 14
   B. 18
   C. 24
   D. 32

26. THE MAIN DISADVANTAGE OF ADJUSTABLE WRENCHES IS THAT THEY:
   A. FIT MORE THAN ONE SIZE
   B. DO NOT HOLD ADJUSTMENT
   C. COME IN SHORT LENGTHS
   D. COME IN VARIOUS SIZES

27. THE TYPE OF PLIERS USED EXTENSIVELY FOR PULLING COTTER PINS ARE THE:
   A. DIAGONAL
   B. LONG-NOSE
   C. COMBINATION SLIP-JOINT
   D. VISE-GRIP

28. THE SIZE OF OPEN-END WRENCHES INCREASES IN:
   A. 1/16 IN. STEPS   B. 1/32 IN. STEPS
   C. 1/8 IN. STEPS   C. 1/4 IN. STEPS

29. THE CHANNEL-LOCK PLIERS ARE DESIGNED TO:
   A. LOCK CHANNELS
   B. HAVE ADJUSTABLE OPENINGS OF DIFFERENT SIZES AND, AT, THE SAME TIME, THE JAWS REMAIN PARALLEL

30. THE END OF A PHILLIPS-TYPE SCREWDRIVER IS:
   A. FLAT BALDE
   B. POINTED END WITH FOUR GROOVES

31. A SETSCREW WRENCH HAS:
   A. FOUR SIDES
   B. SIX SIDES
   C. EIGHT SIDES

32. WHEN USING A CHISEL, IT SHOULD BE HELD:
    A. TIGHTLY IN THE HAND
    B. WITH A PAIR OF SLIP-JOINT PLIERS
    C. LOOSELY IN THE HAND

33. A SCREW EXTRACTOR HAS:
    A. TAPERED RIGHT-HAND THREADS
    B. TAPERED LEFT-HAND THREADS

34. HACKSAW BLADES ARE MADE OF:
    A. HIGH GRADE TOOL STEEL
    B. CHILLED CAST IRON
    C. CARBALOY

35. WHAT IS THE USUAL CUTTING LIP ANGLE ON A TWIST DRILL?
    A. 20°
    B. 59°
    C. 75°

FORM I-2

Curriculum A.M. 51
Course/Unit Title Using a Micrometer

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________________
Date ____________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 3	No. 3	No. 3
By the end of the unit, the student will be able to use a micrometer as an aid in measuring engine parts.	He must measure and interpret micrometer reading with 100% accuracy.	A. Instructor's Evaluation Materials Needed: 1. A micrometer 2. An object to measure (Measurements already known to instructor) B. Instructor Signs Off Job Sheet on Micrometer Unit
	Must pass written test at 70% accuracy	C. Completion Test on Micrometer (Parts and Reading Diagram of Micrometer Reading) You have been provided with a micrometer and objects to measure. Measure each and show me your answers. You must achieve 100% accuracy. You will also be required to: 1. Point to micrometer and its parts; name them orally and in writing (in notebook). 2. Try to adjust micrometer to correct dimension. 3. Select correct micrometer for inside or outside measurement. 4. Solve problem in selecting correct size and type of micrometer. 5. Fill in part names in a diagram.

FORM J-2

Course/Unit: A.M. 51

T.P.O # Micrometer

Level of Mastery: ____________

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS FOR TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
1. Types of micromenters: recognize by appearance	Function of micrometers Types of micrometers	Place calipers on object correctly	NONE	NONE	NONE
2. How to use micrometer	Parts of micrometers	Tighten thimble correctly			
3. How to read and write decimals		Compare micrometer reading to a standard			
4. Recognize a micrometer and its parts					
5. Perceive that micrometers are built with different ranges					
6. Perceive micrometers are built for different tasks					
7. Select correct micrometer for task assigned					
8. Know and identify parts of micrometer					

FORM K-2

Course/Unit: A.M. 51

T.P.O. # Micrometer

LEARNING SEQUENCE

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
See J-2.	Evaluation to occur following instruction at the comprehension level. See Criterion Measure on I-2.	Use 8 millimeter loop film on how to use a micrometer (types of). Slide-cassette program. Have more 1 inch micrometers for students to practice on (approximately 15). Also have premeasured objects to measure. Job-specific programs for using a micrometer for a designated tasked.	Use all listed under Alternate Methods/Media.

FORM I-2

Curriculum A.M. 51

Course/Unit Title #4 Measure Cylinder

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________________

Date ____________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 4 (A): Measuring Cylinder By the end of the unit the student will be able to measure with micrometer a cylinder and determine whether or not it is serviceable as is.	No. 4: Measuring a Cylinder Measurements to be done according to service manual, 100% conformity to manufacturer's specs: by end of unit.	No. 4 Material Needed: A. Take a cylinder, an inside micrometer, an outside micrometer and/or a dial indicator and a manual. Determine whether cylinder meets manufacturer's specifications.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: AM 51

T.P.O # 4 (A) Measuring a Cylinder

Level of Mastery: Evaluation

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Know what a cylinder is, its construction and use.	Explain types and purposes of cylinder and how it works.	Demonstrate ability to use micrometer, knowledge of where to measure cylinder.	Measure cylinder section: determine top ring travel wear. Measure bottom of cylinder for taper. Check for out of round.	Compare micrometer reading to service manual.	Determine if a cylinder measures in conformity to manufacturer's specs.
How to use a micrometer.	Explain why measurement is necessary.	Read and find needed data in manual.			
How to measure a cylinder with micrometer.	Explain how to use micrometer in this case and where.				
Know how to use service manual.					

FORM K-2

Course/Unit: A.M. 51

LEARNING SEQUENCE

T.P.O. # (A)

Measuring a Cylinder

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
Is sequence of Form J-2, as derived, appropriate? (See Form J-2 for sequence, under RECALL.)	Pass written MCT test in classroom, at end of unit, covering RECALL: minimum 70%. Complete Criterion Measure from I-2 to test comprehension through evaluation.	Readers/aides to supervise and inspect work, Scantron test materials, Film or film strip/cassette showing A & B on I-2 (Criterion Measure),	Laboratory assistant, Film or film strip/cassette showing A & B on I-2 (Criterion Measure),

FORM I-2

Curriculum A.M. 51

Course/Unit Title Measuring a Crankshaft to Check for Wear

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst

Date

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 5 By the end of the unit, the student will be able to measure, with a micrometer, a crankshaft and determine whether or not it is serviceable as is.	No. 5 Work to be done according to service manual. 100% conformity to manufacturer's specifications by end of unit.	No. 5 In class or shop: Take a crankshaft, an outside micrometer, 2 V-blocks, and a manual. Put crankshaft in blocks, remove mainbearings, measure. Compare measurement to manual. Write results. Instructor will check measurement.

FORM J-2

Course/Unit: A.M. 51

T.P.O # 5 Measuring Crankshaft for Wear

Level of Mastery: ____________

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Micrometer types	How to use specific micrometer (inside/ outside).	How and where to place micrometer.	Understand what actual micrometer reading means in terms of evaluating condition of crankshaft.	Compare micrometer reading to specifications.	Decide on serviceability of crankshaft.
Design and function of crankshaft					
Why worn or bent crankshaft must be corrected.	Why worn or bent crankshaft must be corrected.				
Where to measure a crankshaft.		Write down measurement. Compare it to manual specs.			

Course/Unit: A.M. 51

LEARNING SEQUENCE

FORM K-2

T.P.O. # 4 Measuring a Crankshaft for Wear

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
Same as J-2.	Recall and Comprehension: Answer questions on MCT test about kinds of micrometers (75%).	Students work closely with instructor or assistant who explains and corrects, if necessary.	Teaching assistants to monitor each student's work.
	Respond to questions on MCT test (75%).	Individualize A-V presentation showing all steps for student.	Individualize A-V presentation showing all steps for student.
	Show in notebooks knowledge of crankshafts		
	Application through Evaluation: See Criterion Measure on I-2.		

FORM I-2

Curriculum A.M. 51, #6

Course/Unit Title Engine Disassembly and Assembly Procedures

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________________

Date ____________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 6 By the end of the unit, the student will have disassembled an automobile engine in the auto shop, cleaned the engine, judged whether to rebore and/or re-ring cylinders and/or crankshaft, and reassembled the engine.	No. 6 By the end of the unit, the engine must be reassembled 100% according to manufacturer's manual.	No. 6 After removing engine from car, proceed to disassemble it, following procedure sheet steps. After the engine is disassembled and cleaned: 1. Measure crankshaft and cylinders to determine their condition. 2. If either needs correction, do what is necessary to make the crankshaft or cylinder meet manual specifications. 3. Reassemble the engine according to specifications. Test it. If further correction is needed, make it. Re-test until engine works properly.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51

T.P.O # 6 Engine Disassembly and Re-Assembly Procedures

Level of Mastery: ____________________

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Shop safety rules and behaviors. What tools are needed for tasks in disassembly and assembly. The parts of the engine (by sight and name). How to measure crankshaft or cylinder with micrometers and dial indicators. Steps required to re-assemble engine. Safety steps.	Types and designs of engines. Why proceed in orderly manner. Importance of crankshaft and cylinder condition. What steps to take to service crankshaft or cylinder. How to clean engine, why, and where. How safety steps protect you.	Having removed engine from car, in the shop disassemble and clean the engine. Determine if cylinder and crankshaft meet manual specifications. After service, if needed, reassemble. Follow all safety rules.	Remove engine from car. Take it apart, following attached procedure sheet steps. Decide, after measuring crankshaft and cylinder, whether either requires reboring or re-ringing or whether they are usable without service.	Compare your micrometer and/or dial indicator measurements with appropriate manufacturer's specifications. Identify condition of key parts and then test the engine.	Test engine to determine: 1. is engine assembled according to specifications? 2. does it run? 3. do further repairs need to be made?

FORM K-2

Course/Unit: A.M. 51, Engine Disassembly and Reassembly Procedures LEARNING SEQUENCE

T.P.O. # 6

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
See procedure sheet attached to J-2.	Recall and Comprehension: Pass a written MCT test at 70%. Application - Evaluation: Test reassembled engine and submit it to instructor's evaluation. See Criterion Measure on I-2.	Films/film strips showing step-by-step disassembly and reassembly of engine. T.A. to help supervise and assist students. Large charts showing sequence of steps - available on easels so student can set one up for reference near his work station - can be referred to at a glance. Video-tape demonstration. Instructor disassembles an engine in front of class: commenting, questioning, checking, etc.	All of those listed under Alternate Methods/Media.

ENGINE DISASSEMBLE PROCEDURE

AFTER REMOVING ENGINE FROM CAR PROCEED AS FOLLOWED:

1. STEAM CLEAN ENGINE
2. REMOVE DRAIN PLUG AND DRAIN OIL
3. REMOVE FREEZE PLUG ON SIDE OF BLOCK AND DRAIN WATER
4. PUT ENGINE ON WORK BENCH (SECURE WITH BLOCKS)
5. REMOVE DISTRIBUTOR
6. REMOVE CARBURETOR AND INTAKE MANIFOLD
7. REMOVE ROCKER COVERS
8. REMOVE ROCKER ARM SHAFT ASSEMBLY OR LOOSEN ROCKER ARM NUT
9. REMOVE PUSH RODS
10. REMOVE VALLEY COVER
11. REMOVE HEADS (BE SURE TO MARK LEFT OR RIGHT HEAD)
12. REMOVE FUEL PUMP
13. REMOVE WATER PUMP
14. REMOVE VIBRATION DAMPER- ON SOME ENGINES IT IS NESSESARY TO REMOVE OIL PAN BEFORE PROCEEDING
15. REMOVE TIMING COVER
16. REMOVE TIMING GEAR AND CHAIN
17. PULL OUT ALL LIFTERS
18. PULL OUT THE CAM SHAFT
19. DISCONNECT THE TRANSMISSION (4 VOLTS ON STANDARD) AND REMOVE. ON AUTOMATIC TRANSMISSION, PULL CONVERTER AND TRANSMISSION AS ONE UNIT.
20. REMOVE OIL FILTER
21. REMOVE PRESSURE PLATE AND CLUTCH
22. REMOVE BELLHOUSING
23. REMOVE ENGINE MOUNTS

24. REMOVE STARTER

25. REMOVE OIL PAN

26. REMOVE OIL PUMP (ON SOME ENGINES REMOVE SPLASH PAN)

27. MARK ALL RODS AND CAPS WITH NUMBER STAMPS. ON THE SIDE WHICH IS OPPOSITE THE CAMSHAFT.

28. IMPORTANT--MARK ALL MAIN BEARINGS (I.E. #1, #2 . . .)

29. REMOVE RIDGE FROM ALL CYLINDERS

30. REMOVE ROD NUT

31. REMOVE ROD CAP

32. INSTALL RUBBER BOOTS ON ROD BOLTS TO PROTECT CRANKSHAFT

33. PUSH PISTON AND ROD OUT OF BLOCK AND INSTALL CAP AND NUT ON THE ROD

34. REPEAT ON EACH PISTON AND ROD ASSEMBLY UNTIL ALL OF THEM ARE OUT

35. REMOVE MAIN BEARING CAPS

36. REMOVE CRANKSHAFT

37. MEASURE BLOCK AND CRANK AND CAM

38. MAKE JUDGMENT ON WHETHER TO REBORE OR RE-RING

39. REMOVE ALL FREEZE PLUS AND CAM BUSHINGS

40. HOT TANK DEGREASE ENGINE (NOTICE--DO NOT PUT ANY ALUMINUM PARTS IN THE HOT TANK)

41. STEAM CLEAN ENGINE BEFORE ANY ASSEMBLY WORK

ENGINE ASSEMBLY PROCEDURE

1. Install cambushing (be careful not to damage bushings).
2. Install all freeze plugs and galley plugs on all sides of the block.
3. Lube cambushing with assembly lube.
4. Install camshaft.
5. Install all main bearings on block.
6. Install rear main bearing seal (upper half).
7. Lubricate all mainbearings with assembly lube.
8. Set the crankshaft on the block gently.
9. Put rear main seal (lower half) on the main bearing cap.
10. Put mainbearing (lower half) on the main bearing caps.
11. Put all main caps on and torque. Install flywheel (flex plate).
12. Remove one cap and check oil clearance with plastigage.
13. Install cam gear, crank gear and timing chain.
14. Check rod and piston assembly: check rod alignment (align if needed); check ring end gap; check side clearance (between grove and ring) and regroove if needed; check rist pin (install new pins if needed); check rod big end for roundness (recondition if needed).
15. Install rings on all pistons (oil ring bottom groove).
16. Lubricate the rings with engine oil SAE #30.
17. Compress rings with ring compressor.
18. Install rubber protectors on rod bolts; lubricate rod bearings.
19. Insert piston into the cylinder with marks of piston to the front of engine and the oil hole of the rod opposite the camshaft.
20. Push piston into the cylinder with a soft hammer until the ring compressor is free of the piston.
21. Hold and guide the rod to the crankshaft while pushing the piston in all the way.
22. Install the correct rod cap and nuts and torque to specifications.

Engine Assembly Procedure (Continued)

23. Repeat #16 through #22 on each piston and rod assembly.

24. Install new timing cover seal onto the time cover.

25. On some engines, install oil sling on crankshaft.

26. Install timing cover.

27. Install oil pump (lubricate with engine oil). On some engines install splash pan and oil pipe.

28. Install oil pan gasket.

29. Install oil pan (be sure drain plug is tight).

30. Install lifters.

31. Install head gaskets and set heads on block.

32. Install head bolts and torque to specification.

33. Install push rods and rocker arms or rocker arm assembly.

34. Install valley cover gasket and valley cover on some engines.

35. Install intake manifold gaskets and intake manifold.

36. Install distributor: a) bring number one piston to T.D.C.; b) put distributor in with rotor pointing to #1.

37. Adjust valve clearance.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51

T.P.O # Re-size Big End of Connecting Rod

Level of Mastery: ____________________

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Use of micrometer. Use of service manuals. Use of dial indicator. Use of tools. Use of honing unit. Assembly of rod and cap. Safety rules.	Why connecting rod must be right. How to disassemble and reassemble rod. How to measure rod. How to hone rod, if necessary. How safety rules protect you.	Comparison of measurements to manual. Determining whether rod as measured meets bearing manual specs. and on that basis evaluating whether rod is usable. If it needs work, decide what should be done. Hone rod, if necessary. (See attached Procedure Sheet.) Follow all safety rules.			

FORM K-2

Course/Unit: A.M. 51

LEARNING SEQUENCE

T.P.O. # 6 Re-size Big End of Connecting Rod

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
Sequence: From little to big.	Recall and Comprehension:	Have T.A. check rod and dial indicator before each student tries engine.	All those listed under Alternate Methods/Media.
See J-2.			
	In shop, during operation, student will explain, orally, function of connecting rod and why it must be right.	Film strip showing step-by-step procedure.	
		T.A. supervised honing practice.	
	Student will answer MCT questions pertaining to TPO #6 in class at mid-term.	Video demonstration.	
	Application: Student will show knowledge and willingness to use Manual and micrometer correctly and will follow procedure sheet in notebook and make appropriate notebook entries of his own project. Instructor inspects notebook.		
	Per Criterion Statement on I-2.		

PROCEDURE SHEET
ROD RECONDITIONING

1. Determine rod bore size from specification manual.

2. Adjust dial indicator gage to read rod bore size.

3. Select honing unit to fit rod.

4. Disassemble rod and remove bolts.

5. Grind rod end and cap.

6. Assemble rod and cap. Torque bolts.

7. Set up hone and resize rod until bore size is correct.

Materials Needed:

1. Torque wrench
2. Brass mallet
3. 1/2" socket
4. 2" - 3" micrometer
5. Honing unit
6. Honing stones
7. File
8. Rod
9. Vise

FORM I-2

Curriculum A.M. 51

Course/Unit Title Rebore Cylinders

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________________

Date ____________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 8 By the end of the unit, the student will be able to rebore a cylinder.	No. 8 The reboring will be done in the auto shop according to service manual, 100% conformity to manufacturer's specs. by end of unit.	No. 8 Take an engine cylinder, boring bar, micrometers (inside and outside), boring bar tool kit and proceed according to procedure sheet. Instructor will measure with micrometer to check work.

FORM J-2

Course/Unit: A.M. 51

T.P.O # 8 Rebore Cylinders

Level of Mastery: ____________

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS FOR TERMINAL PERFORMANCE OBJECTIVE

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
What a cylinder is. Function of cylinder. Tools to be used and how to use them. How to use appropriate micrometers. How to check for manual specifications. Safety measures in lifting and grinding.	How cylinder works and why it must be right. What measurements will show. How to interpret findings.	See attached procedure sheet.	Plan steps to be followed.	Check findings against manual.	Determine whether work done has brought cylinder to manufacturer's specs.

Course/Unit: A.M. 51

T.P.O. # 8 Rebore a Cylinder

LEARNING SEQUENCE

FORM K-2

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
See attached procedure sheet.	Recall and Comprehension: Pass MCT test at 70%, in class, at end of unit. Application through Evaluation: Perform job at 100% according to manufacturer's specs. Instructo signs worksheet upon satisfactory completion of task. See Criterion Measure in I-2.	Film and/or film strips showing step-by-step procedure: A. Preparation B. Measurement C. Manual Specifications D. Computation of Amount of Boring to be Done and Where to Bore E. Boring Bar and Boring Bar Tool Kit F. Sharpening Tool G. Use Tool H. Check Work A film or film strip, review of tools used in re-boring. Teaching Assistant to help supervise tasks. Video-tape demonstration.	

PROCEDURE SHEET FOR REBORING CYLINDER

Rebore cylinder:

a. Prepare cylinder block surface. Remove studs and pins. Crossfile if necessary.

b. Measure cylinders and determine amount of removal.

c. Select correct size anchor and bolt and secure in cylinder to be bored.

d. Carefully, carry boring machine, less motor, and place one surface of cylinder block. (Have help when carrying heavy equipment.)

e. Slide machine over anchor bolt and roughly align bar over cylinder to be machined.

f. Select correct set of centering pins and install in bar. Retract centering pins by turning upper knob of bar c/clockwise.

g. Slowly lower bar into cylinder, centering as necessary, to selected centering depth.

h. Expand centering pins by turning upper knob of bar clockwise until bar is centered. Do not apply too much pressure.

i. After centering bar, lock machine to anchor.

j. Retract centering pins and remove.

k. Select correct tool and sharpen.

l. Adjust micrometer to selected rebore diameter (if rebore is over .020", more than one cut is necessary). Allow .0015" to .002" for finishing.

m. Install cutter holder in bar and place micrometer in bar with ring to left; bottom micrometer and turn ring to right. Lock Cutter Holder.

n. Remove micrometer.

o. Shift lever to low speed.

p. Mount motor and lock.

q. Adjust depth scale and stop.

r. Start motor and snap lever at wheel.

s. Check cut closely.

FORM I-2

Curriculum A.M. 51 #9
Course/Unit Title Fit Wrist Pins

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst
Date

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 9	No. 9	No. 9
By the end of the unit, the student will have measured a wrist pin bushing to determine if it is usable or needs to be replaced. If it needs to be replaced, he will change the bushing and re-size it to fit the wrist pin.	100% conformity to manufacturer's specifications as to clearances. The work must be checked with a dial indicator until it is in conformity to specifications.	Using a piston, wrist pin bushings, wrist pin, and shop specification manual, determine by measuring with a dial indicator gauge if the rod, piston, and wrist pin are in accordance with manufacturer's specifications. If it is not, change the bushing and resize it to fit the wrist pin. The instructor will evaluate and inspect work to determine if it meets manufacturer's specifications.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51
T.P.O # 9 Fit Wrist Pins
Level of Mastery: ____________

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
1. Use of micrometer. 2. How to use manual. 3. What is a dial indicator. 4. How to use it. 5. Purpose of piston. 6. Function of wrist pins and bushings. 7. Use of wrist-pin re-sizing machine.	What the dial indicator can show. Why clearances must be correct in bushings for wrist pins. What can happen if clearances are not according to specifications.	Measure. Re-size wrist pin bushing, using appropriate tool. Re-measure. (See attached procedure sheet.)	Measure pin and bushing with dial indicator. If wrist pin bushing must be replaced, follow procedure sheet attached.	Compare findings to manual.	Make a judgment on usability of wrist pin bushings, or, if bushing as been re-placed, whether it meets specifications.

FORM K-2

Course/Unit: A.M. 51

T.P.O. # 9 Fit Wrist Pins

LEARNING SEQUENCE

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
See attached procedure sheet and recall on J-2.	Recall and Comprehension: Pass MCT test at 70% in class by end of unit. Application and Evaluation: Perform task 100% in conformity to manufacturer's specifications. Instructor's inspection. See Criterion Measure on I-2.	Film and/or film strip showing step-by-step procedure. T.A. to help supervise tasks.	

PROCEDURE SHEET
WRIST PIN FITTING

1. Replace piston pin bushings. (Use hand-held driver.)
2. Select correct honing mandrel (.840, .900, etc.).
3. Select correct honing stone (7, 9, 12 grit).
4. Set dial gage to read pin size. (Use 2 plus as a standard.)
5. Hone bushings to fit wrist pin (.0008-.001 clearance).

FORM I-2

Curriculum A.M 51

Course/Unit Title Service Valves and Valve Seats

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________________

Date ____________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 10 By the end of the unit, the student will be able to disassemble a cylinder head and determine what service work is required to rebuild the head to meet the manufacturer's specifications.	No. 10 Work is to be done in the shop according to service manual, 100% conformity to manufacturer's specs. by the end of the unit. Must pass written test at 70% accuracy.	No. 10 Take a cylinder head, spring compressor, brass mallet, disassemble head and proceed according to procedure sheet (attached) to determine whether the head meets manufacturer's specifications or must be rebuilt. If it must be rebuilt, do so according to manufacturer's specifications.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51

T.P.O # 10 Service Valves and Valve Seats

Level of Mastery: ____________

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
What cylinder head is. Correct tools to use and how to use them. How to disassemble Where procedure sheet is--and follow it. How to use Manual. How to use micrometer.	Why it is necessary to disassemble the head to check valve and valve seats. Why it is necessary to grind valves and valve seats.	Take cylinder head apart. Clean all parts, examine them, measure them. Service where needed.	See attached criterion measure sheet for TPO #9.	Comparison of cylinder head seats and valves, valve springs to manufacturer's service manual.	After disassembly, determine what service work is required to rebuild cylinder head to meet manufacturer's specs. Determine if repair meets manufacturer's specifications.

FORM K-2

Course/Unit: A.M. 51

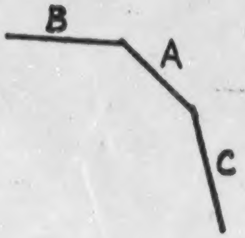
LEARNING SEQUENCE

T.P.O. # 10 Service Valves and Valve Seats

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
See cylinder head service procedure and/or J-2 (application)	Recall and Comprehension: At end of unit, in class, student must pass 70% questions on MCT. Application - Evaluation: During shop work, the instructor observes to see if procedures are being carried out. When project is finished, instructor will inspect it for 100% conformity to manufacturer's specs. See the Criterion Measure on I-2.	Use 8 millimeter loop film on how to service a cylinder head. Slide-cassette program on servicing cylinder heads. Teaching assistant to help supervise procedures and to inspect finished work. Video demonstration.	

CYLINDER HEAD SERVICE PROCEDURE

1. DISASSEMBLE HEAD - (SPRING COMPRESSOR, HAMMER, AND OLD PISTON PIN)
2. CLEAN VALVES - (WIRE BRUSH, CHECK FOR STEM WEAR, DISCARD BAD VALVES)
3. CLEAN CYLINDER HEAD AND COMBUSTION CHAMBERS - (HOT TANK AND STEAM CLEAN) (SCRAPE CARBON BEFORE GLASS BEADING)
4. CHECK HEAD SURFACE FOR STRAIGHTNESS. (SURFACE IF NECESSARY)
5. DEBURR SHARP EDGES IF HEAD HAS BEEN SURFACED
6. GLASS BEAD COMBUSTION CHAMBERS
7. MAGNAFLUX AND VISUALLY CHECK FOR CRACKS
8. CHECK RUNOUT AND MARGIN
9. GRIND AND REFACE VALVE (CHECK SPECIFICATIONS)
10. GRIND STEM END AND CHAMFER
11. RECONDITION VALVE GUIDES - (KNURL OR REPLACE)
12. CUT GUIDE FOR SEALS
13. GRIND VALVE SEATS - (NARROW IF NECESSARY)
    - A. 45 - SEAT ANGLE
    - B. 15 - 30 NARROW STONES
    - C. 60 - NARROW CUTTER



14. CHECK SEAT CONTACT AREA AND SEAT WIDTH
15. CHECK VALVE STEM HEIGHT
16. CLEAN HEAD WITH STEAM BEFORE ASSEMBLY
17. LUBE GUIDES, VALVES, SEALS, AND INSTALL
18. CHECK SPRING TENSION AND INSTALLED SPRING HEIGHT (SHIM IF NECESSARY)

FORM I-2

Curriculum #11 A.M. 51

Course/Unit Title How to Position Distributor and Time Engine

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________

Date ____________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 11 By the end of this unit, the student will be able to set a distributor in an engine correctly and time the engine 100% in accordance with manufacturer's specifications.	No. 11 The engine must run after the distributor is replaced. Timing must match manufacture's specifications, plus or minus 2 degrees.	No. 11 Using an engine which needs to be timed, a manufacturer's service manual, install a distributor correctly. Test it with engine running. Use timing light to time the engine while it is running. Inspection by instructor will follow completion of timing.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51

T.P.O # 11 How to Position Distributor and Time Engine

Level of Mastery: ____________

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Use of manuals.	What your engine's firing order is.	Install a distributor in an engine.	Determine, by manual, arrangement of engine and firing order.	What to do if the distributor does not fit all the way down.	Decide when task is completed in 100% compliance with manufacturer's specifications.
Arrangment of engines.	Which is #1 spark-plug?	Time the engine so that it runs smoothly.	Set distributor according to attached procedure sheet.		
Which tools are needed for task.	Which is #1 piston?		Time and test distributor and set spark plugs.		
What distributor is and what it does.	Function of timing marks.				

FORM K-2

LEARNING SEQUENCE

Course/Unit: A.M. 51

T.P.O. # 11 How to Position Distributor and Time Engine

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
See attached procedure sheet.	MCT questions on unit test: must pass at 70%. Complete worksheets and submit work for instructor's evaluation.	Film/film strip showing step-by-step installation and positioning of distributor and use of timing light in setting spark plugs. T.A. to help supervise and evaluate work. Film or film strip explaining where timing goes wrong and what happens. Video demonstration (must have sound).	

ENGINE IGNITION TIMING PROCEDURE

1. Determine engine to be timed.
2. Look up cylinder arrangement of engine in manufacturer's service manual.
3. Look up firing order of engine in manual.
4. Remove #1 spark plug and crank engine over and position #1 piston near T.D.C. in firing position.
5. Align timing marks.
6. Install distributor, positioning the vacuum advance unit according to manufacturer's service manual with rotor pointing to #1 spark plug wire on distributor cap.
   Note: if distributor does not fit all the way down, the oil pump drive shaft is not connected to distributor shaft, so crank engine over until distributor drops into place. Then position #1 piston T.D.C. in firing position.
7. Rotate distributor against rotation so the points just open.
8. Tighten distributor, hold down, and install distributor cap.
9. Install spark plug wires starting with #1 in the rotation of the distributor; according to the firing order, install the rest of the spark plug wires.
10. Connect timing light and start engine. Final setting will be with engine operating, vacuum line disconnected, engine at idle RPM.

FORM I-2

Curriculum A.M. 51 #12

Course/Unit Title Engine Troubleshooting

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________

Date ____________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 12	No. 12	No. 12
By the end of the unit, the student will be able to diagnose engine problems and determine what service work is required to repair engine to meet manufacturer's specifications.	Trouble shooting work is to be done in the auto shop according to the service manual, 100% conformity to the service manual, by the end of the unit. Must pass MCT at 70% accuracy.	Using an engine and diagnostic tools, determine if your engine is in accordance with manufacturer's specifications or if it needs correction, write a recommendation for correction. 100% instructor's evaluation.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51

T.P.O # 12 Engine Troubleshooting

Level of Mastery: ____________________

Refer to: Taxonomies--SAFE Manual, pps. . 3-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Principles of internal combustion. Engine fundamentals. Basic fuel and electrical systems. Use of manuals. Use of diagnostic equipment. Procedures to be followed in troubleshooting.	Causes of abnormal noises. Causes for loss of compression. Causes for oil leakage or excessive use. Cause of engine smoking. Causes of poor engine performance.	Turn on engine, test spark plugs and conduct visual inspection. Engine off: Test inside of engine with diagnostic equipment.	Follow procedures outlined on procedure list.	Compare findings in engine to manufacturer's specifications. Look for alternate explanations if necessary.	Decide at each step whether the part examined is functioning satisfactorily. For each part found not to be functioning properly, prescribe what should be done to make it conform to manufacturer's specifications.

FORM K-2

Course/Unit: A.M. 51

T.P.O. # 12 Engine Troubleshooting

LEARNING SEQUENCE

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
Follow procedures outlined in textbooks.	The student will examine, listen, and disassemble an engine to discover its deficiences. He will, using manufacturer's manual, determine what needs to be done to make engine perform properly. Evaluation is done by instructor's inspection and double-checking on work done. See Criterion Measure on I-2.	Film and film strip with sound track of noises. Questions and responses built in. T.A. to assist in supervision and inspection.	

ENGINE DIAGNOSIS

Condition and Possible Cause

Engine Will Not Start

1. Weak battery.
2. Corroded or loose battery connections.
3. Loose ground connections for battery and/or engine.
4. Faulty starter or solenoid.
5. Moisture on ignition cables and distributor cap.
6. Faulty ignition cables.
7. Faulty coil.
8. Incorrect spark plug gap.
9. Incorrect ignition timing.
10. Dirt or water in fuel line or carburetor.
11. Carburetor flooded.
12. Incorrect carburetor float setting.
13. Faulty fuel pump.
14. Carburetor percolating (vapor lock).
15. Sticking choke.
16. Defective neutral starting switch.
17. Defective ignition switch.
18. Air cleaner obstructed.
19. Faulty emission control units.
20. Faulty ignition distributor.

Engine Stalls

1. Idle speed set too low.
2. Incorrect choke adjustment.
3. Idle mixture too lean or too rich.
4. Incorrect carburetor float setting.
5. Intake manifold leak.
6. Worn distributor rotor.
7. Incorrect ignition wiring.
8. Faulty coil.
9. Incorrect valve lash (mechanical lifters).
10. Carburetor float needle valve inoperative.
11. Float level incorrect.
12. Choke defective or incorrectly set.
13. Moisture on ignition cables and plugs.
14. Loose engine and battery grounds.

Loss of Power

1. Incorrect ignition timing.
2. Defective or maladjusted emission control system.
3. Worn or burned distributor rotor.
4. Dirty or incorrectly gapped spark plugs.
5. Dirt or water in fuel line.
6. Clogged air cleaner.
7. Incorrect carburetor float setting.
8. Faulty fuel pump.
9. Incorrect valve timing.
10. Blown cylinder head gasket.
11. Leaking engine valves.
12. Restricted exhaust system.
13. Faulty ignition cables.
14. Faulty coil.
15. Weak valve springs
16. Low float level.
17. Incorrect valve lash (mechanical lifters).
18. Lean air-fuel mixture.

Engine Misses on Acceleration

1. Dirty spark plugs or gaps too wide.
2. Incorrect ignition timing.
3. Dirt in carburetor.
4. Defective accelerator pump in carburetor.
5. Leaking engine valves.
6. Faulty coil.
7. Weak valve springs.
8. Sticking engine valves.
9. Lean air-fuel mixture.

Engine Misses at High Speed

1. Dirty spark plugs or gaps too wide.
2. Worn distributor shaft.
3. Faulty coil.
4. Worn or burned distributor rotor.
5. Faulty condenser.
6. Incorrect ignition timing.
7. Clogged carburetor jets.
8. Dirt in fuel line.
9. Leaking engine valves.
10. Sticking engine valves.
11. Incorrect valve lash.
12. Worn valve lifters.
13. Worn engine cams.
14. Worn valve guides.

Noisy Valves

1. High or low oil level in crankcase.
2. Thin or diluted oil.
3. Low oil pressure.
4. Dirt in hydraulic lifters.
5. Bent push rods.
6. Worn rocker arms and/or shafts.
7. Worn rocker arms.
8. Worn valve lifters.
9. Excessive runout of valves or seats.
10. Excessive valve lash (mechanical lifters).

Connecting Rod Noise

1. Insufficient oil in crankcase.
2. Defective oil pump.
3. Low oil pressure.
4. Thin or diluted oil.
5. Excessive connecting rod bearing clearance.
6. Rod bearing journals out-of-round.
7. Bent connecting rods.
8. Dirt behind bearing inserts.

Main Bearing Noise

1. Insufficient oil supply.
2. Low oil pressure.
3. Excessive end play of crankshaft.
4. Crankshaft out-of-round.

5. Loose flywheel.
6. Dirt behind bearing inserts.
7. Dirt in oil supply lines.

Noisy Piston Rings

1. Rings striking ridge at top of cylinder wall.
2. Excessive clearance between ring and piston groove.
3. Broken piston ring.
4. Incorrect ring gap.

Noisy Pistons

1. Excessive piston clearance.
2. Collapsed piston skirt.
3. Piston pin incorrectly fitted.
4. Connecting rods incorrectly aligned.
5. Loose piston strut.

Excessive Oil Consumption

1. Worn piston rings.
2. Clogged drain holes in piston rings.
3. Incorrect ring gap.
4. Ring gap incorrectly spaced.
5. Rings installed up-side-down.
6. Excessive oil throw-off from engine bearings.
7. Rings too tight in grooves.
8. Oil level too high.
9. Excessive bearing clearance.
10. Wrong size rings installed.
11. Worn pistons and cylinder walls. See Figs. 17-14 and 17-15.
12. Valve seals damaged or missing.
13. Worn valve stems and guides.
14. Plugged drainback in cylinder head.
15. Worn crankshaft journals.
16. Overheated engine.

External Oil Leakage

1. Defective fuel pump gasket.
2. Defective push rod cover gasket.
3. Defective valve cover gasket.
4. Defective oil filter gasket.
5. Defective oil pan gasket.
6. Defective timing chain cover gasket.
7. Worn timing chain oil seal.
8. Worn rear main bearing oil seal.
9. Loose oil line plugs.
10. Engine oil pan plug improperly seated.
11. Clogged oil drain from rocker area to oil pan.

Low Oil Pressure

1. Low oil level.
2. Faulty oil pressure sending unit.
3. Clogged oil filter.
4. Worn oil pump.
5. Diluted oil.
6. Excessive bearing clearance.
7. Oil pump relief valve stuck.
8. Oil pump suction tube loose, bent or cracked.

Dieseling

1. Check exhaust emission system.
2. Wrong type spark plugs.
3. Excessive carbon in combustion chamber.
4. Poor quality fuel.
5. High engine idle speed.

Burned Valves and Seats

1. Lean air-fuel mixture.
2. Use of lead-free gasoline.
3. Insufficient valve lash.
4. Valve seat too narrow.
5. Valve face too thin.
6. Warped valve head.
7. Worn valve stems and guides.
8. Loose valve seats.

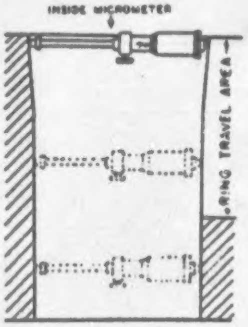


Fig. 17-14. Wear is greatest in ring travel area, causing customary taper at top of cylinder.

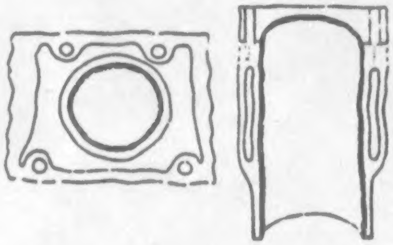


Fig. 17-15. Exaggerated illustration of cylinder distortion caused by unequal or excessive tightening of cylinder head bolts.

ENGINE OVERHEATING

There are many conditions of the automobile that result in overheating, and the degree of overheating is indicated by the temperature gauge on the instrument panel. Or, some models use only a signal lamp on the dash, which lights as a warning when a prescribed high temperature is reached.

Some conditions will cause only a slight change in the recorded temperature, other causes will result in a rapid rise in temperature and violent boiling of the coolant. Still others,

FORM I-2

Curriculum A.M. 51

Course/Unit Title Using Manufacturer's Service Manuals

TERMINAL LEARNING REQUIREMENTS

Curriculum Analyst ____________________

Date ____________________

Terminal Performance Objectives	Criterion Statement	Criterion Measure
No. 13 By the end of this unit the student will be able to look up all data needed to learn what needs to be done to an engine to repair it, what the engine specifications are, what parts are used, etc.	No. 13 Whatever the year or make of a car, upon identification of a problem part, the student will copy with 100% accuracy what the manufacturer's service manual says.	No. 13 Instructor compares student's answer to his key - a photocopy of Manual pages.

FORM J-2

COGNITIVE/PSYCHOMOTOR/AFFECTIVE ANALYSIS
FOR
TERMINAL PERFORMANCE OBJECTIVE

Course/Unit: A.M. 51

T.P.O # Using Manufacturer's Service Manuals

Level of Mastery: ____________________

Refer to: Taxonomies--SAFE Manual, pps. 143-46
Handouts on Taxonomies

RECALL (Memory)	COMPREHENSION (Explanation)	APPLICATION (Apply to simulated or real situation)	ANALYSIS (Break down into parts)	SYNTHESIS (Pull together elements/ solve problems)	EVALUATION (Make judgments)
Where are manuals kept?		Locate and write assigned problems.			
That each manufacturer has a different manual for each year.	Explain what specs. mean in relationship to actual work on cars.				
How to look things up in the Manual.					
Each manufacturer puts out a different manual each year. You have to know year and make of car before looking at manual. Explain meaning of discrepancies between manual and measurements.					
Students practice looking up data and copying it.					
11/18/77 Revised 12/30/77					

FORM K-2

Course/Unit: A.M. 51

LEARNING SEQUENCE

T.P.O. # 13 Using Manufactuer's Service Manuals

LEARNING STEPS	RESPONSE/EVALUATION	ALTERNATE METHODS/MEDIA	METHOD/MEDIA SELECTION
	Recall - Application: See Criterion Measure on I-2.	Teaching Assistant can help administer aid: give problems and help student to solve them in using manuals.	Must have full library of service manuals.

RESEARCH AND DESIGN

PROJECT: MOBILITY

STEPS OF CURRICULUM ANALYSIS

STEP 5

THE FINAL STEP TAKEN BY THE TEAM IS TO PULL TOGETHER ALL THEIR FINDINGS AND RECOMMENDATIONS INTO ONE DOCUMENT. THIS DOCUMENT, IN COMBINATION WITH THE METHODS/MEDIA ALTERNATIVES IDENTIFIED IN STEP 4 WILL BE THE BASIS FOR SPECIFIC PROGRAM CHANGES TO BE IMPLEMENTED IN PHASE III OF THE RESEARCH AND DESIGN PROJECT. IN COMBINATION WITH THE OTHER PORTIONS OF THE PROJECT, I.E., COUNSELING AND GUIDANCE, MANAGEMENT PLANS, EVALUATION AND AUDIT SYSTEMS, THE CURRICULUM DESIGN RECOMMENDATIONS SHOULD ELIMINATE THE HURDLES TO SUCCESS BEING ENCOUNTERED BY DISADVANTAGED AND/OR HANDICAPPED VOCATIONAL EDUCATION STUDENTS. IF THEY DO NOT, THEY WILL BE REANALYZED AND REVISED UNTIL THEY DO.

STEP 5:

A) DEFINE SPECIFIC RECOMMENDATIONS OF PROGRAM/COURSE CHANGE TO ELIMINATE THE IDENTIFIED PROBLEMS AND PRODUCE THE REQUIRED MASTERY.

RESEARCH AND DESIGN PROJECT
AUTOMOTIVE MECHANICS

General Recommendations

I. Identification and Removal of Basic Skills/Knowledge Deficiencies

The first critical problem highlighted through the Committee's analysis begins prior to students' entry into the actual automotive curriculum. This problem centers on basic skills deficiencies which disadvantaged students bring with them to their first day of class. The present system does not allow the automotive instructor to identify the existence or the extent of this problem until the student has already begun a pattern of failure.

It is the recommendation of this Committee, therefore, that the following steps be implemented to identify and remove these deficiencies in disadvantaged students:

a. The use of skill and dexterity tests to determine the basic skills support needed by students wishing to enter the automotive mechanics program. These would include manual dexterity, reading, math and basic study skills, if possible. The instructors should receive these scores on day one of the semester so they can direct students with deficiencies to the proper program or service.

b. Remedial reading, math and dexterity classes specific to Automotive Mechanics should then be made available to those students to assist in bringing them up to required proficiency levels.

c. Students should also be provided with a skills development lab in notetaking, diagram drawing and other basic study skills.

II. Counseling and Registration

It is the finding of this Committee that an additional hurdle is created for the disadvantaged student through inappropriate or incomplete counseling prior to registration and also mistakes in registration which place the disadvantaged student in classes for which he/she is not qualified.

It is the recommendation of the Committee, therefore, that the following revisions in the counseling and registration process be instituted:

a. Counselors should advise students before they sign up for Automotives what class requirements are: buy book, read book, write notebook, take tests--not just shop work.

b. Close registration early for Advanced Automotive Mechanics classes to avoid putting students in just because class is open.

c. The following recommended sequence of courses should be required of all students wishing to enroll in the Automotive Mechanics Program:

Semester I: I.E. 9 (Automotive Essentials); A.M. 51 (Engines); reading and math specific to auto shop.

Semester II: A.M. 52 (Fuels and Electrical Systems); I.E. 11 (Basic Electricity).

III. Methods/Media

Instructional experience and this detailed analysis of disadvantaged students has shown the Committee that these students require increased visual support of abstract concepts, increased reinforcement of repair procedures, and close supervision in the automotive shop if they are to master the required skills to the levels required for employment.

It is the recommendation of this Committee, therefore, that the following method and media modifications be instituted into the Automotive Mechanics classroom and shop to be responsive to these unique learner needs:

a. The addition of a closed circuit T.V. capability which would allow instructors to effectively demonstrate to large groups of students.

b. Access to video tape production capabilities that would allow automotive instructors to create self-directing sequences on identified problem areas in the curriculum. This would allow students to repeat and reinforce these problem areas, on their own, until they were mastered.

c. Provide nearby study carrells for individual use, which can be used by disadvantaged students with film strips, slides or video tapes to individually reinforce the problem areas of the curriculum.

d. Provide a course in basic electricity (I.E. 11) specific to automotives.

e. Develop a safety film specific to auto shops with "do's" and "don'ts".

f. Provide through the addition of a shop assistant on-the-spot individualized laboratory instruction on the use of machines. This person should be someone who knows mechanics, but not an Automotive Mechanics student because students (1) are not good enough and/or (2) won't put in enough time.

g. For the deaf students enrolled in the program, interpreters must know auto mechanics and be able to communicate about it.

IV. Expanded Shop Capabilities

There presently exist equipment and environmental limitations in the automotive shop itself which limit its effective use to reinforce curriculum content and produce mastery of required skills.

It is the recommendation of this Committee, therefore, that the following modifications be made in the existing automotive shop:

a. The replacement of missing tools, thereby assuring a complete set of tools for instructors and disadvantaged students in the shop.

b. A full time tool room attendant is needed (not a student); this person should also do some maintenance on tools and equipment and provide needed security.

c. Automotive Mechanics area needs restrooms.

d. Automotive Mechanics area needs air-cooling/refrigeration. The heat in the summer makes working and studying in the shop extremely difficult.